SHIMADZU

INSTRUCTION MANUAL
PharmaSpec
UV-1700
SERIES
Operation Guide

SHIMADZU CORPORATION

KYOTO JAPAN

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INSTRUCTION MANUAL

Operation Guide

UV-1700

SHIMADZU RECORDING SPECTROPHOTOMETER

P/N 206-55401-91 100V
206-55401-92 120V
206-55401-93 220V
206-55401-94 240V
206-55401-34 230V CE Model

Read the instruction manual thoroughly before you use the product. Save this instruction manual with care so that you can use it any time you need it.

SHIMADZU CORPORATION
ANALYTICAL & MEASURING INSTRUMENTS DIVISION
KYOTO, JAPAN

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Precautions for Safe Operation

UV-1700 is an ultraviolet visible spectrophotometer.

To operate the unit safety, strictly observe the following precautions.

1. Do not use the unit for any purpose other than the above-mentioned types of analysis.
2. Follow the procedures described in the user's manual.
3. Observe all warnings and cautions.
4. Do not disassemble or modify the unit without the express approval of an authorized Shimadzu Representative.
5. For internal repair of the product, contact your Shimadzu Representative.

MEANING OF CAUTION SIGNS

WARNING	**indicates a potentially hazardous situation which, if not avoided, could result in death, serious injury or moderate injury.**
CAUTION	**indicates a potentially hazardous situation which, if not avoided, may result in minor injury, or may result in machine damage.**
NOTE	**is used to emphasize essential information.**

Warning labels indicated on the unit

WARNING

High Temperature

Light source and light source chamber are very hot. When replacing the light source, be sure to turn OFF the power and check that the light source is completely cooled.

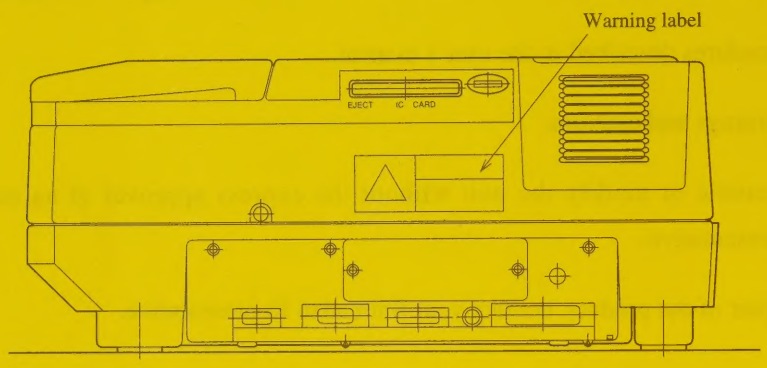

Fig. 1 UV-1700

WARNING

Electric Shock

When replacing the fuse, be sure to turn OFF the power and disconnect the power supply cord.

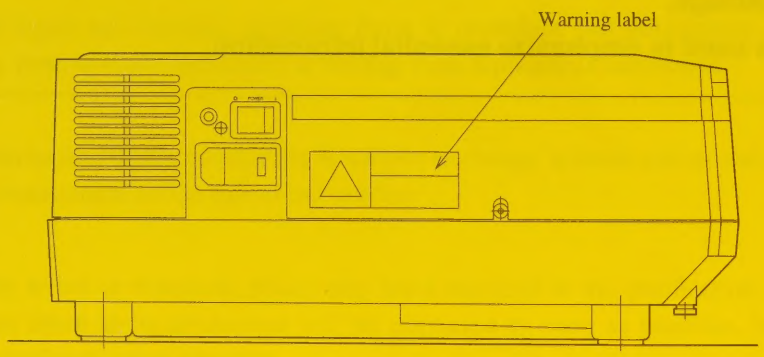

Fig. 2 UV-1700

Preface

Thank you for your purchase of the Shimadzu Recording Spectrophotometer UV-1700.

The UV-1700 is a newly designed instrument equipped with all of the basic spectrophotometer functions in a compact body. The UV-1700 can also be applied to a variety of analysis using our optional software, available on IC cards.

In order for you to fully employ and effectively utilize the functions of this instrument, it is recommended that you carefully read this manual before using the UV-1700, and thereafter keep it close at hand for future reference.

This Instruction Manual (Operetion Guide) describes the operation of this instrument.

In Chapter 1, the basic key operations, etc. will be explained.

The software for this instrument basically comprises 8 modes for measurement (or data processing, instrument parameter setting, etc.). Chapter 2 describes the methods for selecting these modes and the operations which are shared by several of the measurement modes.

From Chapter 3 on, the details about operation in the various modes are explained.

Of the operations which are shared by the various modes, "Sample Module Control" and "PC Control" are treated in detail in Chapter 15 and Chapter 14.

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Chapter 1. Before Operating...

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1.1 Turning ON Power and Initialization

When the power is turned ON, the spectrophotometer is checked and initialized according to the items shown in the screen in Figure 1.1. The time required for this initialization is approximately 4 minutes (5 minutes when the multi-cell is used) if all of the items are properly completed. As each item enters its initialization operation, it is highlighted. Then, when the initialization for that item is properly completed, the star next to it is also highlighted. However, if any abnormality is detected, the initialization process is interrupted at that item, without its star being highlighted. Please refer to the "User's System Guide", "3.2 Initialization and Error Display" regarding the content of the checks performed for each item and the points to check if an error is indicated.

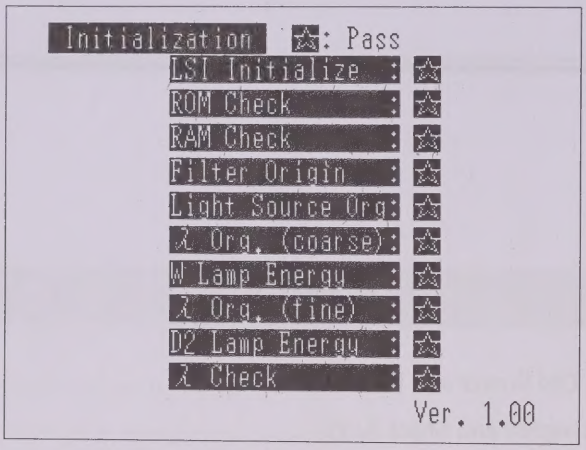

Fig. 1.1 Initialization screen

Note A thin protective film has been applied to the surface of the keyboard. This film will not be a hindrance if the keyboard is used with it in place, but if the film begins to peel during use and makes the keyboard difficult to see, peel it entirely from the surface.

1.2 Screen Display and Sheet Keys

Fig. 1.2 illustrates the relation between the screen of the UV-1700 and the sheet keys. The modes and settings in the various screens can be selected using the number keys 0 through 9 or the function keys F1 through F4. When selecting modes or settings, it is not necessary to press the (ENTER) key after you have pressed the number keys or function key. On the other hand, when entering numeric values, such as wavelength settings orm display mode, etc., you must press the (ENTER) key to confirm that value.

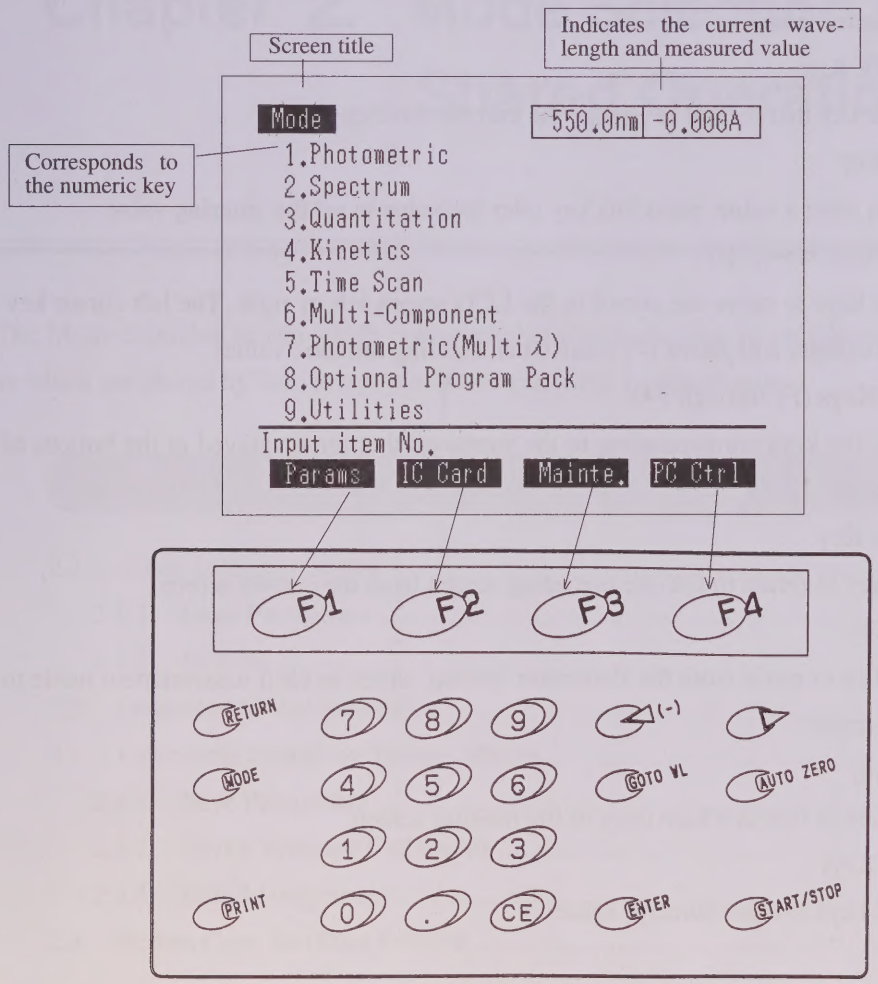

Fig. 1.2 Screen display and sheet keys

The basic function of each key is described below. Some keys may be assigned to special functions depending on the screen.

① START/STOP Key

This is the key for starting and stopping measurement once parameter setting has been completed.

② AUTO ZERO Key

When you press this key, the current wavelength will automatically be set to 0Abs (100%T). Make sure that prior to sample measurement a blank cuvette is placed in both sample and reference sides.

③ GOTO WL Key

This is the key that is used to change the current wavelength.

④ ENTER Key

When you enter a value, press this key after the value to set the entering value.

⑤ Cursor Keys (◁ (–), ▷)

Use these keys to move the cursor in the LCD screen left or right. The left cursor key can also be used to enter a negative (–) value when entering numeric values.

⑥ Function Keys (F1 through F4)

These are the keys corresponding to the functions that are displayed at the bottom of the LCD unit screen.

⑦ RETURN Key

Use this key to return to the one preceding screen from the current screen.

⑧ MODE Key

Use this key to move from the Parameter Setting screen in each measurement mode to the main Mode screen.

⑨ PRINT Key

Use this key to output a hard copy of the monitor screen.

⑩ Numeric Keys

Use these keys to enter numeric values.

⑪ CE Key

Use this key to clear a numeric value entry error. When you press this key, the numeric value which has been entered will be cleared and then you may reenter the appropriate value.

Chapter 2. Mode Selection and Shared Operations

The Mode Selection screen which is displayed after initialization is completed, and the operations which are shared by the various modes are explained in this chapter.

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2. 1 Mode Selection Screen

After the initialization has been completed successfully, the Mode Selection screen appears. Select a desired measurement mode by entering the corresponding item number. The Parameter Configuration screen shown in "2.2 Overview of Various Modes" will appear.

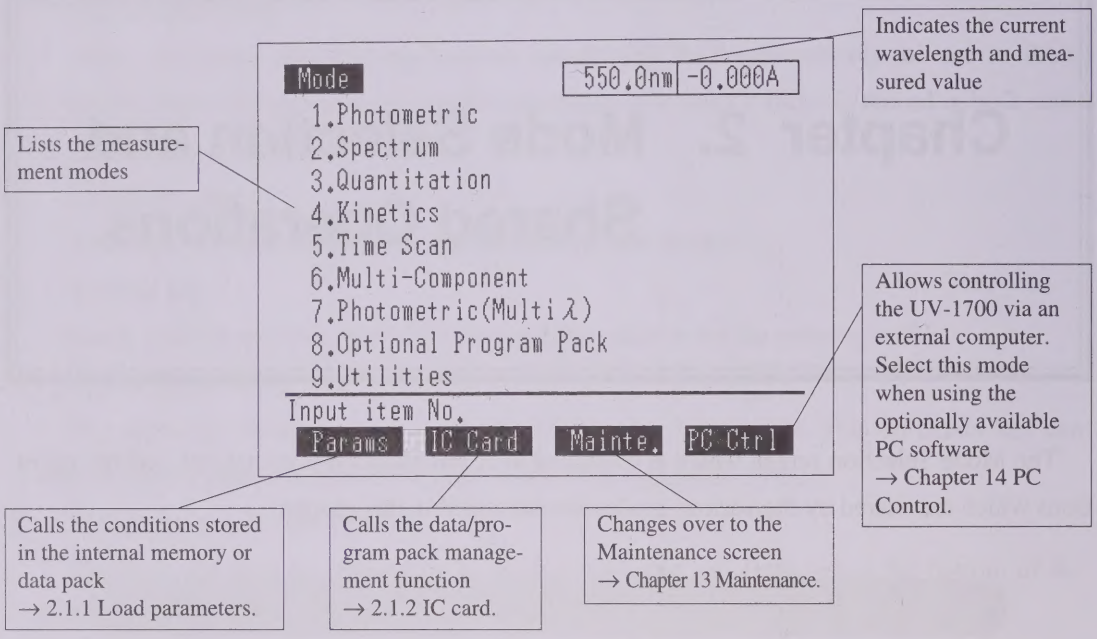


Fig. 2.1 Mode Selection screen

2.1.1 Load Parameters

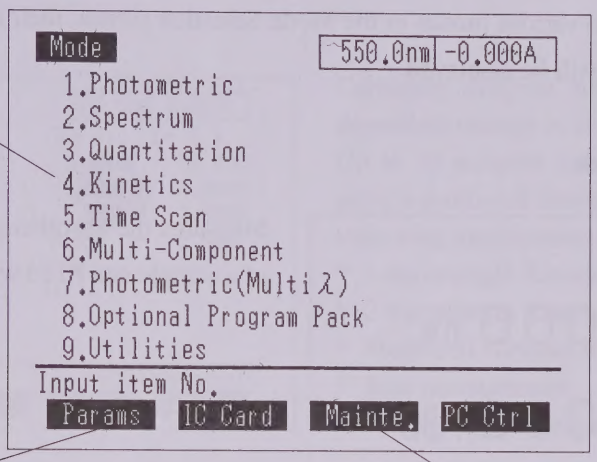
Mode Selection screen (F1) key

In order to facilitate entering measurement parameters for each application, you can save the measurement mode and measurement parameters in memory and then load them from the Mode Selection screen. (Refer to "2.3.1 Save Parameters" about saving measurement parameters.)

Up to 16 sets of measurement parameters can be stored in the instrument memory, and if a data pack (option) is used, a total of 95 parameter sets can be stored.

When you select [Params], the parameter file list will be displayed.

You can also use the (◁) (▷) keys to change the page displayed in the Parameter file list screen.



Lists the stored parameters files

Used to specify the file number to be loaded. After the file number has been entered, the parameters are automatically set and the Parameter Configuration screen appears in the measurement mode.

Used to delete a file. Specify a file number and then delete it.

Fig. 2.2 Param file list screen

2.1.2 IC Card

There are 3 functions available for the optional IC cards (data pack and program pack).

When the IC card (F2) key is pressed on the Mode Selection screen, the Data/Program pack utilities screen appears.

① Data pack initialize

This function is the equivalent of a disk format on a personal computer.

A data pack absolutely must be initialized before it is used.

CAUTION! Initializing a data pack that is in use will delete all of the information stored on it.

② Data pack copy

This function copies the contents of one data pack to another data pack. Please note that the optional program pack cannot be copied.

③ Program pack check

This is to check the contents of the program pack. The results of the title, mode No., version no. and check sum (check for content errors) checks will be displayed.

2.2 Overview of Various Modes

When you select the various modes in the Mode Selection screen, their respective Parameters Configuration screens will be displayed.

① Photometric mode

```
Photometric
  λ  :
        500.0 nm
  Data  :
        0.002 ABS

%T / ABS  SmplCntl  SmplMeas  SavParam
```

Measures the absorbance or % transmittance of a sample at a fixed wavelength.

(See Chapter 3 Photometric)

② Spectrum mode

```
Spectrum                  500.0nm  0.001A
1.Meas. mode     :  ABS
2.Scanning range:   500 nm ~   400 nm
3.Rec. range     :  0.00A  ~   2.00A
4.Scan speed     :  Medium
5.No. of scans   :  1
6.Display mode   :  Sequential

Input item No.            (START:Measure)
 BaseCorr  CallCurv  SmplCntl  SavParam
```

Scans a wavelength range to measure the absorbance and % transmittance of a sample as a function of wavelength.
Single beam energy measurement can also be performed.
Data processing such as peak detection, smoothing, and arithmetic calculation may be applied to the measured spectrum.

(See Chapter 4 Spectrum)

③ Quantitation mode

```
Quantitation              700.0nm  0.000A
1.Meas.    : 1λ
   λ1= 700.0
2.Method  : K-factor (C=K*ABS+B)
                        K=   1.0000
                        B=   0.0000
3.No. of Meas.   :  1
4.Unit           :  ppm
5.Data print     :  NO

Press START key for measurement
(Select item No. for param. change)
          SmplCntl  SmplMeas  SavParam
```

Creates a calibration curve from a standard sample and quantitates an unknown sample.
Measurement methods are
1-wavelength method
2-wavelength method
3-wavelength method
Derivative quantitation
In addition, the following methods are available for calibration curve generation
K-factor method
Single point calibration curve method
Multi-point calibration curve method

(See Chapter 5 Quantitation)

④ Kinetics mode

```
1 λ                          500.0nm  0.001A
1.Meas. time     :   100 sec  Δ= 0.1
  Lag  / Rate    :    10 sec/   90 sec
2.Factor         : 1) 1.0000 2) 1.0000
                   3) 1.0000 4) 1.0000
3.Rec. range     :   0.00A  ~   2.00A
4.Temp. control  :  None
5.Time scale     :  sec

Input item No.              (START:Measure)
 CallCurv  DataList  SmplCntl  SavParam
```

Calculates enzyme activity from the time-dependent change in absorbance.
Up to 16 samples can be measured at once using a multi-cell holder (options).
Following measurement methods are available.

* 1-wavelength Kinetics measurement
* 2-wavelength Kinetics measurement
* Multi-cell Kinetics measurement
* Rate measurement

(See Chapter 6 Kinetics)

⑤ Time Scan mode

```
1cell                        500.0nm  100.0%
1.Meas. mode     :  T%
2.Meas. time     :   60 sec  Δ= 0.1
3.Rec. range     :    0%  ~   100%
4.Time scale     :  sec
5.Temp. control  :  None

Input item No.              (START:Measure)
 CallCurv          SmplCntl  SavParam
```

This function is used to measure the change in time of absorbance, transmittance, or energy in the fixed wavelength. Up to 16 samples can be measured using the multi-cell (options). Data processing such as arithmetic calculation may be applied to the measurement data.

(See Chapter 7 Time Scan Mode)

⑥ Multi-componento mode

```
Multi-Component              500.0nm  0.000A
1.Scanning range :  500 nm  ~   400 nm
2.Rec. range     :  0.00A  ~   2.00A
3.Scan speed     :  Medium
4.Display mode   :  Sequential
5.No.of component:  4
6.Standard type  :  Mixed
7.No.of Standard :  16
8.Meas. λ        :   Undefined
9.Standard data  :   Undefined
Input item No.
 BaseCorr          SmplCntl
```

Enables samples with up to 8 constituent components to be measured and quantitated. Using a pure product for each component as a standard sample, create calibration curve data and then perform the quantitation.

(See Chapter 8 Multi-component)

⑦ Photometric (Multi λ)

```
Photometric(Multi λ)   500.0nm  0.000A
  1.Meas. mode   :  ABS
  2.Meas. points :  8
      λ1= 500.0 nm   λ2= 480.0 nm
      λ3= 460.0 nm   λ4= 440.0 nm
      λ5= 420.0 nm   λ6= 400.0 nm
      λ7= 380.0 nm   λ8= 360.0 nm
  3.Equation:A1-A2, A1/A2, dA(A1~A3)

  4.Change sample:     NO
Input item No.
 BaseCorr  SmplCntl  MeasDisp  SavParam
```

Specify a maximum of eight arbitrary wavelengths and then measure absorbance and transmittance at each of those wavelengths. When absorbance is measured, the measurement result may be output by selecting one of three equations based on data on up to four wavelengths.

- Ratio/difference between the measured values for two wavelengths and calculation of three wavelengths
- Calculation using four data equations
- Calculation using four data equations

where Kn is coefficient and An absorbance.

(See Chapter 9 Multi-wavelength Measurement Mode)

⑧ Optional Program Pack

```
DNA/Protein              260.0nm  0.528A
1.  λ      :λ1=  260.0nm  λ2=  230.0nm
2.Background Corr.  :NO    λb=  320.0nm
3.Factor   : K1 =  49.100  K2 =  3.4800
             K3 =  183.00  K4 =  75.800
Equation   D N A   Conc.= K1*A1 - K2*A2
           Protein Conc.= K3*A2 - K4*A1

Input item No.            (START to Meas.)
 BaseCorr  PrntForm  SmplCntl  SavParam
```

Select this when using the optional program pack.

Shown left is the optionally available DNA/Protein screen.

(See Chapter 10 Optional Program Pack)

⑨ Utilities

```
Utilities
  1.Start program    : Standard menu
  2.Data display     : 4
  3.S/R exchange     : Standard
  4.Light source     : 340.8
  5.Printer          :
    ( L.margin = 8 )
  6.Clock set        : 01/01/31 10:12:18
  7.D2 lamp off time:  ∞
  8.Beep             : ON

Input item No.
```

This is the mode for setting and changing the basic operating parameters of the instrument.

(See Chapter 12 Utilities)

⑩ Maintenance

```
Maintenance
  1.Validation
  2.Instrument Baseline Correction
    Corrected date : 01/01/30 19:36:32
  3.Lamp time used
    WI Lamp :        98hours
    D2 Lamp :        75hours

Input item No.
```

This mode provides the functions to validate the performance of the UV-1700, to control the lamp illumination time, and to correct the baseline of the UV-1700 for the maintenance purpose.

(See Chapter 13 Maintenance)

⑪ PC control

```
PC control
λ :
        260.0nm
Data :
        0.528ABS
Light :
        D2
```

This mode allows the UV-1700 to be controlled by the external computer.
Also select this mode when using the optionally available PC software.

(See Chapter 14 PC Control)

2.3 Operations Shared by Various Modes

Operations which are shared by several of the modes will be explained here. The operations which are unique to the various modes will be explained in the chapter on the respective mode.

2.3.1 Save Parameters

Photometric	Parameter Configuration screen	(F4) key
Spectrum	Parameter Configuration screen	(F4) key
Quantitation	Parameter Configuration screen	(F4) key
Kinetics	Parameter Configuration screen	(F4) key
Time Scan	Parameter Configuration screen	(F4) key
Multi-wavelength	Parameter Configuration screen	(F4) key

This is the function for saving measurement parameters for the current measurement mode in the instrument memory or a data pack (option). The stored parameters can be loaded using [Params].

When you select [Sav Param], a parameter file list is displayed.

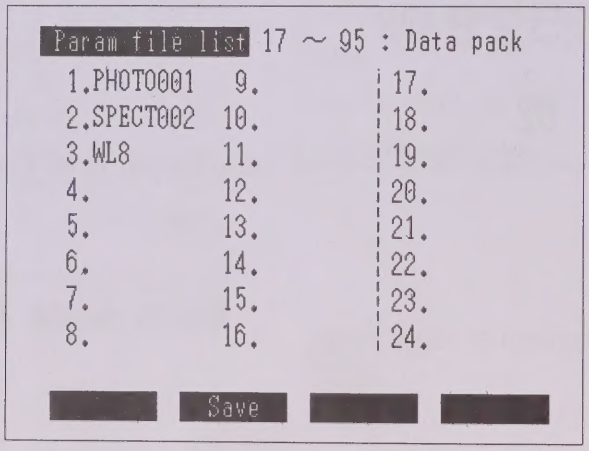


Fig. 2.3 Parameter file list

Note	Note that the measurement parameter of accessory is connected to sample compartment is not saved.

When you select [Save] and enter the file No. in which the parameters are to be saved, Character input screen will be displayed.

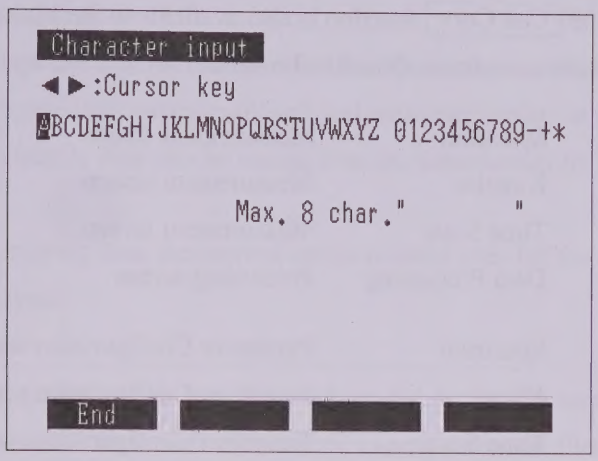


Fig. 2.4 Character input screen

Use the (◁) (▷) keys to move the cursor to the character that you wish to enter and then press the (ENTER) key to input the character. The characters 0 through 9 can be directly entered by pressing the corresponding number key. (Up to 8 characters)

If you make a mistake entering a character, you can delete it with the (CE) key.

The space between the Z and 0 (zero) is a "space" which can also be entered. However, a "space" can not be placed at the front of a filename.

When you are finished entering and select [End], the measurement parameters will be saved to the file of the specified number under the filename which was entered.

2.3.2 Save Curve and Call Curve

[Sav Curve] is the function which saves spectrum data or time course data to a file.

Also, [Call Curv] is the function for loading to the screen curves which have been saved in a file.

Up to 6 curves can be saved in the instrument memory, while a total of 32 can be saved if an optional data pack (option) is used.

Of these, the data measured in the immediately preceding measurement are automatically saved in the dedicated File No. 0 (zero) under the filename "Original", and data cannot be manually saved to this file using [Sav Curve].

These functions for handling curves are available in the Spectrum, Kinetics, Time Scan, and Data Processing modes.

In addition, the [Call Curv] function is also available in the Multicomponent mode. (Chapter 8 Multi-component Quantitation Mode)

[Sav Curve]	Spectrum	Measurement screen	(F4)	key
	Kinetics	Measurement screen	(F4)	key
	Time Scan	Measurement screen	(F4)	key
	Data Processing	Processing screen	(F4)	key
[Call Curv]	Spectrum	Parameter Configuration screen	(F2)	key
	Kinetics	Parameter Configuration screen	(F1)	key
	Time Scan	Parameter Configuration screen	(F1)	key
	Multi-component	Measurement screen	(F2)	key
	Data Processing	Item Selection screen	(F2)	key

When you select [Sav Curve] or [Call Curv], a Curve file directory is displayed on the screen. Now, if there are no measurement data from an immediately preceding measurement, the [Save] function will not be displayed.

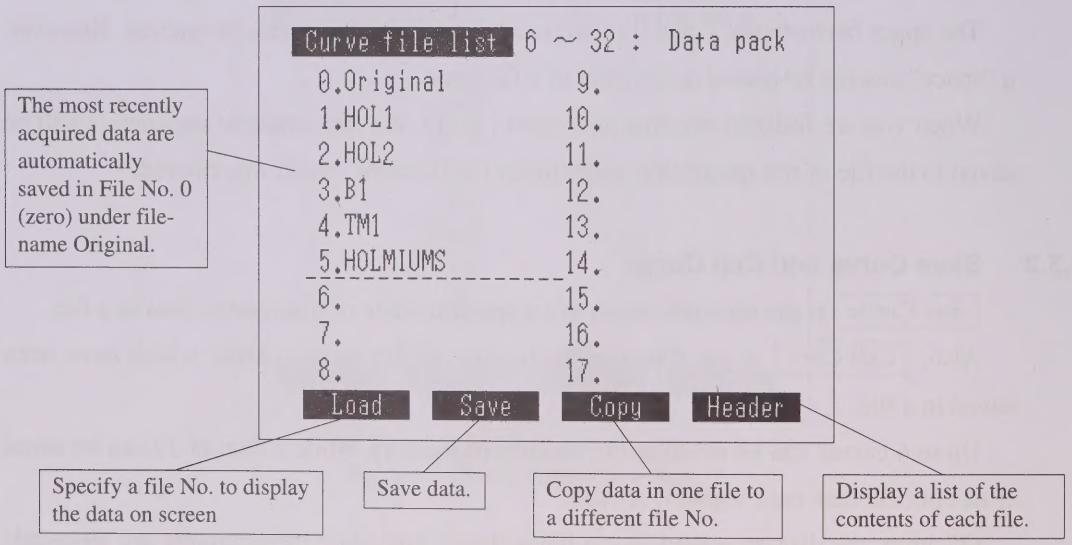


Fig. 2.5 Curve file directory screen

The displayed page of the Curve file directory screen can be switched using the (◁) (▷) keys.

Load

This displays the data for the specified file No. on the screen.

If the data type (the vertical axis unit and measured mode are the same) and horizontal axis units match, data can be overlaid on the same screen by consecutively entering file Nos.

When overlaying data, the vertical and horizontal axes for the initially displayed data will be displayed.

Note Since the files which are displayed on the curve file screen or the data file screen use the same area of memory, exactly identical files will be displayed. Consequently, the data files for the various modes are mixed together. Files of different modes cannot be displayed on screens of the measurement mode.

Save

This saves measured or processed data in memory areas No. 1 through 32.

When you press Save, you will be instructed on the screen to enter a file No. When you enter a file No. 1 through 32, the Character input screen will be displayed.

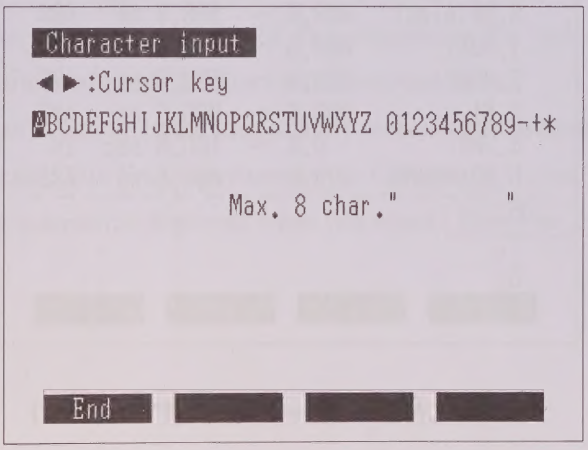


Fig. 2.6 Character input screen

Use the ◁ ▷ keys to move the cursor to the character that you wish to enter and then press the ENTER key to input the character. The characters 0 through 9 can be directly entered by pressing the corresponding number key. (Up to 8 characters)

If you make a mistake entering a character, you can delete it with the CE key.

The space between the Z and 0 (zero) is a "space" which can also be entered. However, a " space" can not be placed at the front of a filename.

When you are finished entering and select End, the measurement parameters will be saved to the file of the specified number under the filename which was entered.

Copy

You can copy data between file Nos. 0 through 32. Specify the copy source and copy destination file Nos. as instructed on the screen. No. 0 can't be specified as the destination.

Header

You can display the range of the horizontal axis (measurement time or wavelength range) and the units thereof (sec, min, nm) as well as the units of the vertical axis (ABS, T%, E) in the list (Curve file list) so as to see the type of data saved in each of the file Nos. 0 through 32.

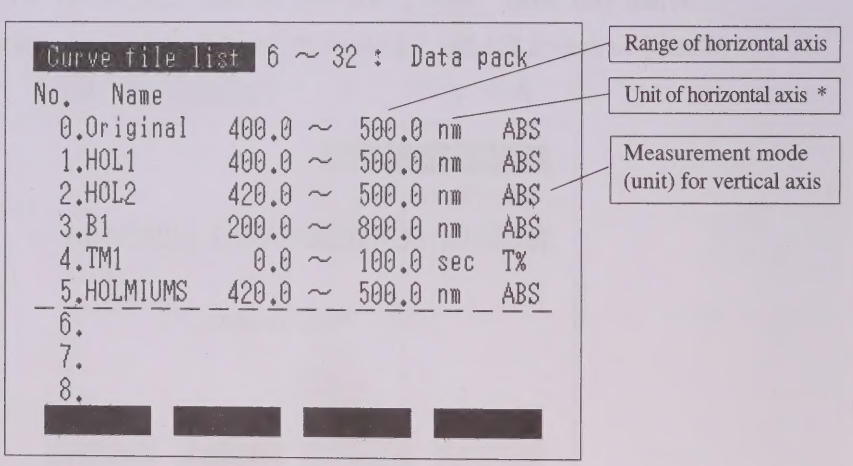


Fig. 2.7 Curve file list screen (Header)

* The data for Photometrics or Quantitation will display the measured wavelength. In the 2λ or 3λ quantitation, the longest wavelength will be shown. The data for Kinetics measurements done using a multi-cell or CPS-240 (both option) has a special format in which up to 16 curves can be simultaneously saved in one file. Therefore, "Particular Format" will be displayed with those data.

File No. 0 "Original"

The most recently acquired data are automatically saved in the dedicated File No. 0 (zero) under the filename "Original".

The screen can be returned to the immediately preceding condition after file processing, such as display, copy, or data processing ("Chapter 11 Data Processing") have been performed by loading file No. 0.

Other data cannot be saved in file No. 0.

2.3.3 Data Management

Photometric	Measurement screen	(F2)	key
Quantitation	Measure Unknown Sample screen	(F2)	key
Kinetics	Data Display (Data table)	(F1)	key

Numeric data tables, such as the photometric values and concentrations obtained in the Photometric and Quantitation modes, can be saved to and loaded from the instrument memory or an data pack (option).

Up to 6 files of data tables can be saved in the instrument memory, while if an data pack (option) is also used, a total of 32 files can be saved.

In addition, the maximum quantity of data comprising the various data tables is 166 data for Photometric mode and 182 data for Quantitation mode.

Of these, the table data up to the immediately preceding measurement are automatically saved in the dedicated File No. 0 (zero) under the filename "Original".

The Data file list screen is displayed when you select Data File.

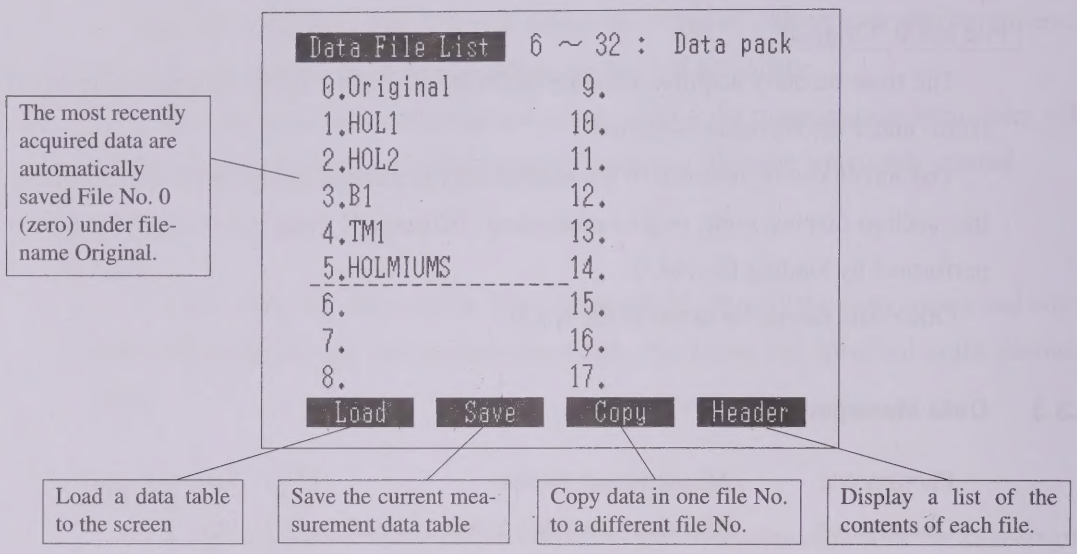


Fig. 2.8 Data File List screen

The operation of each function is the same as [Sav Curve] and [Call Curv].

Now, if there are no measurement data from the immediately preceding measurement, the [Save] function is not displayed.

2. 4 Screen Copy and Data Printout

When the thermal printer DPU-414 (optional) (P/N 206-55215-××) is installed, the UV-1700 can print out hard copies of the screen or the measurement results. Connecting this printer makes the following 3 types of printouts possible.

(1) Hard copy of screen: Press the (PRINT) key to print a hard copy of the screen.

(2) Print using function keys: When a function key has a [Print Out] function, as in a mode such as Photometrics in which the measurement results are recorded in table form, all of the tabular data will be printed out.

(3) Print numeric data for: In modes in which the measurement results are obtained as numeric values, as each measurement is acquired (as with Photometric) these measurements will automatically be printed.

The UV-1700 can be connected to a commercially available printer for personal computer that supports to the printer control code ESC/P-9 or ESC/P-24 of EPSON. Connecting to the printer complied with ESC/P enables following output in addition to the above mentioned three types of printouts.

(4) Print waveform

In the spectrum mode and kinetics mode, it is possible to plot the waveform (spectrum) on A4 size paper when it is displayed on the screen. It is half as large as A4 paper. Examples in each mode by the 24-pin printer are displayed in Fig. 2.9 and Fig. 2.10.

By pressing the (PRINT) key while the waveform is being displayed, printing of the waveform or its hard copying can be selected.

For the connection of the printer, refer to the "Appendix B Printer" of the "Instruction manual - User's System Guide".

Epson's printer control codes

ESC/P-24-84

- 84: Functional standard of printer: Indicates the highest standard among 84>83>82>81>80.
- 24: 24-pin dot printer, 9: 9-pin dot printer
- ESC/P: Indicates Epson's printer control system.

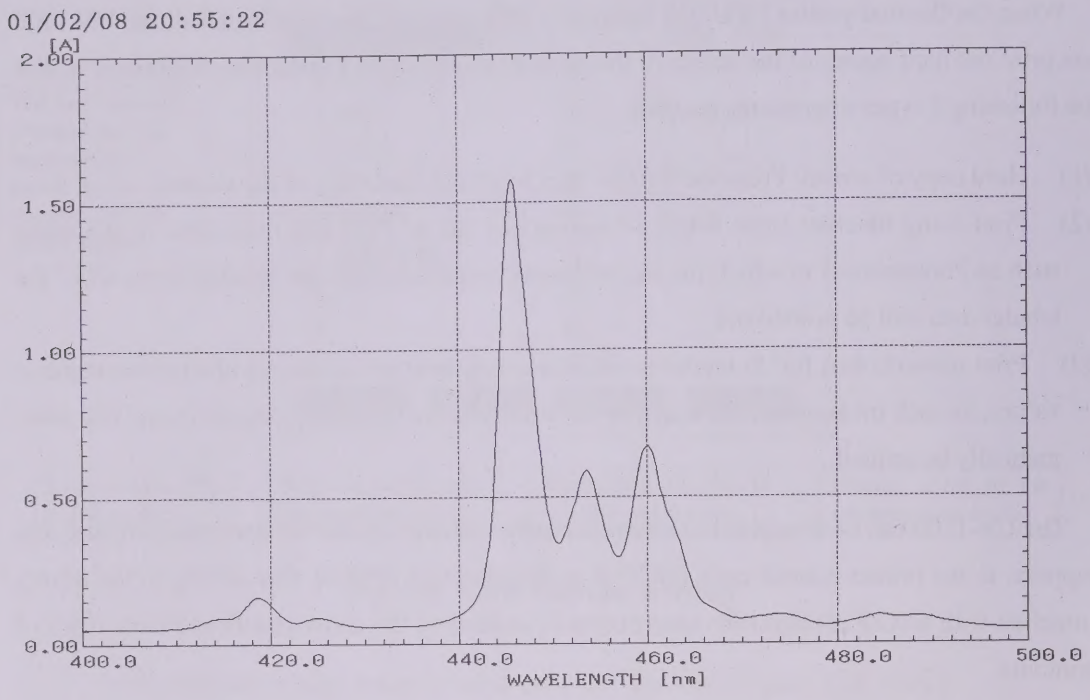


Fig. 2.9 Waveform print (Spectrum mode)

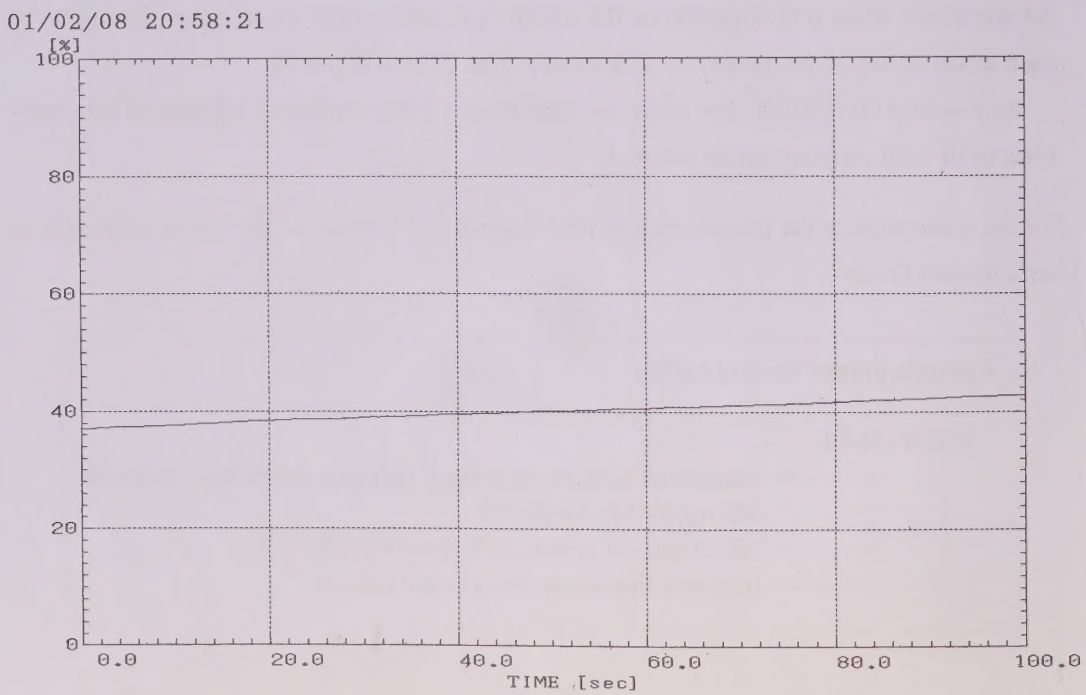


Fig. 2.10 Waveform print (Kinetics mode)

Chapter 3. Photometric Mode

The photometric mode is used to measure absorbance (ABS) or transmittance (T%) at an arbitrary fixed wavelength.

To repeat the measurement, the measurement results may be displayed as a list. A single list allows including a maximum of 166 measurement results, which may be stored as a single file in the memory.

This is a simple quantitation method. A sample concentration C is expressed as C=K × ABS, and when the value for K (K = Conc. of Std / absorbance of Std) is already known, you can enter the value for K and measure the concentration of unknown samples.

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3. 1 Measurement Parameter Configuration Screen

When you select <1. Photometric> in the Mode Selection screen, the measurement parameter configuration screen will be displayed.

To specify the measurement wavelength, use the (GOTO WL) key.

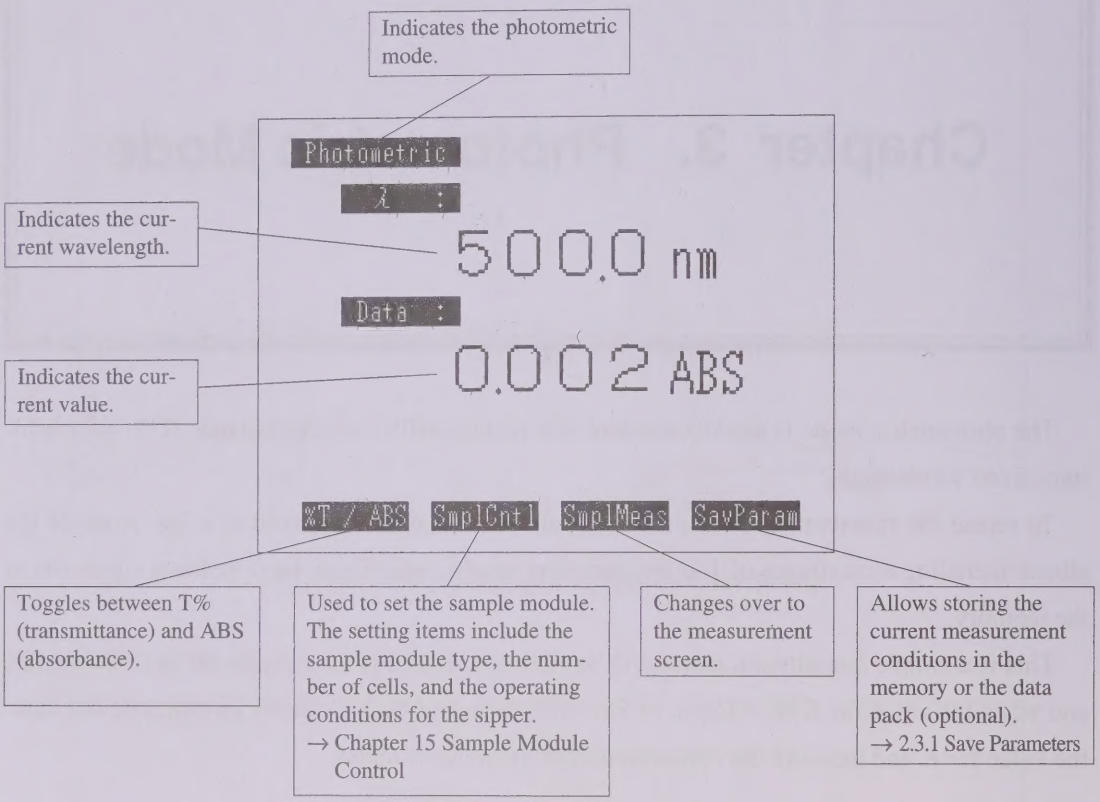

Fig. 3.1 Measurement parameter configuration screen

When the (START/STOP) key is pressed, the measurement will be started with the measurement screen (Fig. 3.2) displayed.

If blank correction is required, set the blank sample prior to the measurement and then press the (AUTOZERO) key. The measured value will be set to 0 ABS (100%).

Information on analog output

In this screen, measured values can be output in analog signal at fixed intervals by using the optional analog output interface. For the analog output interface, refer to the analog output interface manual.

3.2.1 Measurement Screen

Specify the conditions and then press the (F3) key (measurement screen) or the (START/STOP) key. The measurement screen will appear.

(If the (START/STOP) key is pressed, the first measurement run will be carried out with the measurement screen displayed.)

Different sample numbers will be assigned between the case in which the standard cell holder, the 160 sipper (optional), and the syringe sipper (optional) are used (Fig. 3.2) and the case in which the multi-cell and the CPS-240 (both of which are optionally available) are used (Fig. 3.3).

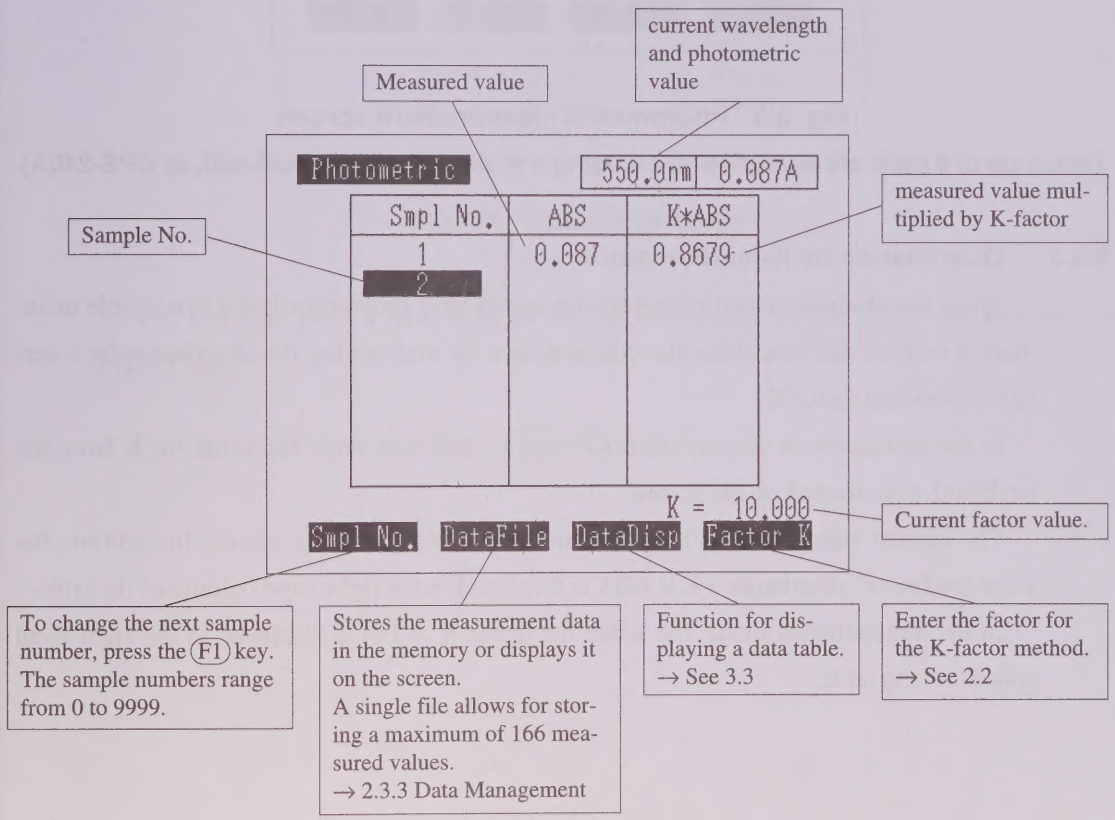

Fig. 3.2 Photometric measurement screen
(for standard cell holder or when only one cell is being used)

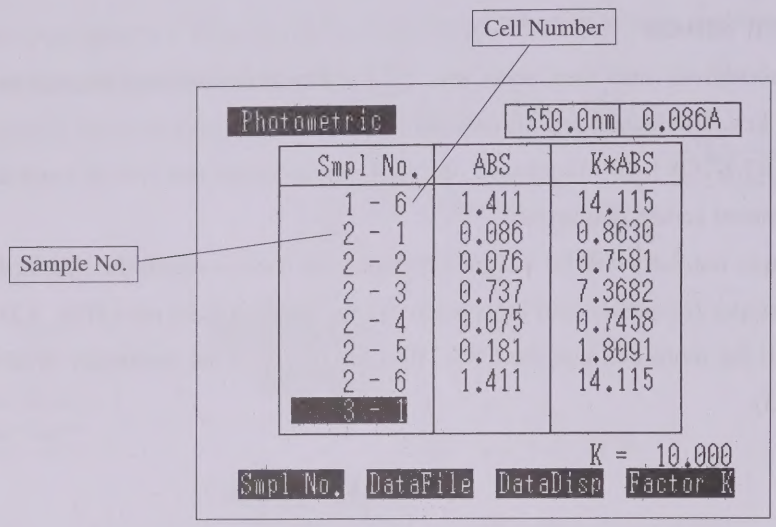

Fig. 3.3 Photometric measurement screen
(when up to 6 cells are occupied when using a multi-cell, micro multi-cell, or CPS-240A)

3.2.2 Quantitation by K-factor method

When the absorbance and concentration are directly proportional, this is a simple quantitation method that calculates the concentration by multiplying the absorbance by a certain conversion factor K.

In the measurement screen, select Factor K and then enter the value for K from the keyboard as instructed on the screen.

The current value for K is displayed in the lower-right of the screen. In addition, the value for factor* absorbance =K × ABS is displayed in the right-hand column of the table.

In the transmittance mode, the value for factor K × T% is displayed in the right-hand column of the table.

3.2.3 Data Print and Screen Copy

When a printer (option) is connected, the measurement results will be printed on the printer for every measurement.

No.	ABS	K*ABS
1	0.086	0.8630
2	0.086	0.8630
3	0.086	0.8630
4	0.086	0.8630
5	0.086	0.8630
6	0.736	7.3621
7	0.736	7.3584
8	0.736	7.3584
9	0.736	7.3621
10	0.736	7.3621
11	0.077	0.7666

Fig. 3.4 Sample printout

You can also print a hard copy of the current screen on the printer by pressing the (PRINT) key.

3.3.1 Data Display screen

As the measurement is repeated on the measurement screen, the data will be scrolled with only the latest seven measurement results displayed on the screen. The Data Display screen is used to list the measurement results including those which have disappeared from the screen. It also allows printing out the data table or deleting data.

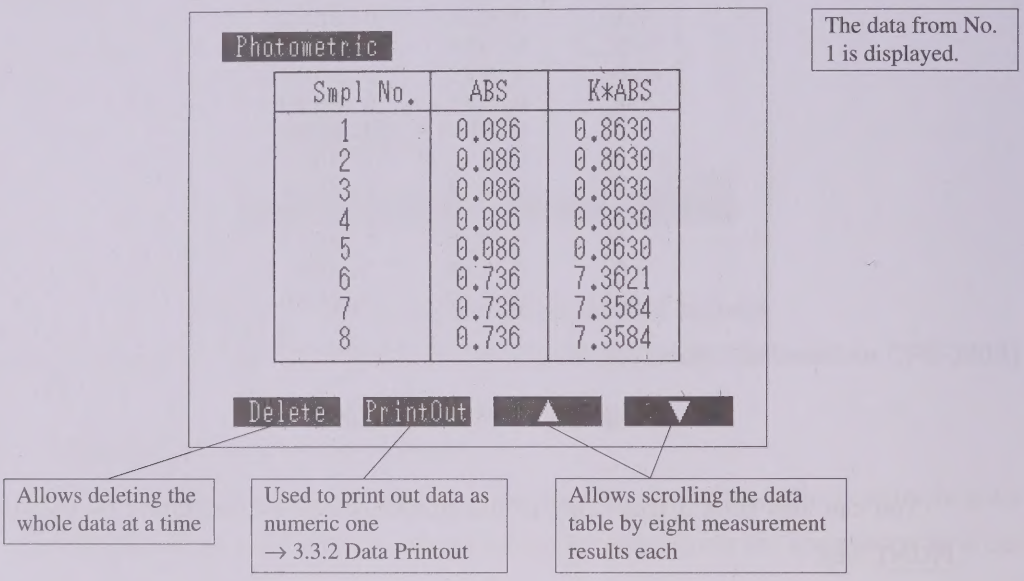

Fig. 3.5 Data Display screen

3.3.2 Data Printout

The whole data may be printed out as a numeric data table on the printer (optional). (Pressing the (PRINT) key on the keyboard will produce a hard copy of the displayed screen.)

No.	ABS	K*ABS
1	0.086	0.8630
2	0.086	0.8630
3	0.086	0.8630
4	0.086	0.8630
5	0.086	0.8630
6	0.736	7.3621
7	0.736	7.3584
8	0.736	7.3584
9	0.736	7.3621
10	0.736	7.3621
11	0.077	0.7666
12	0.077	0.7666
13	0.077	0.7666
14	0.077	0.7666
15	0.077	0.7666

Fig. 3.6 Sample of printout

At this time, the same data is output to the RS-232C port.

The data output format is exactly the same as in the sample of printout shown in Fig. 3.6. At each line end, the [CR](0Dh) and [LF] (0Ah) codes are output. At the end of the data, the [SB] (1Ah) code is output .

The transmission parameters for the RS-232C port are as follows:

Baud rate	: 9600 bps
Data bit length	: 7
Stop bit	: 1
Parity	: Odd number
X parameter	: None

For the connection cable, see "14.1 Connecting to a PC" of Chapter 14.

Note The external transfer function is used to mono-directionally transfer data from the UV-1700 to an external personal computer. This transfer continuously occurs at a rate assuming that the data will be loaded to the personal computer. The data is output at intervals of nearly 20 ms via the RS-232C port. This rate is good enough for almost every personal computer to receive the data. However, some personal computers of a low processing rate might fail to receive the whole data. If the transferred data is to be printed out by connecting a printer with small capacity of its internal buffer via the RS-232C port, all of that data might not be printed out.

Chapter 4. Spectrum Mode

The spectrum mode is used to measure spectra. Measure the absorbance and transmittance spectra of the sample by performing the wavelength scan. This mode also allows you to measure the energy of a light source using its single beam.

The measured spectra may be stored as a single file in the memory. Data processing such as peak detection, smoothing, and arithmetic calculation may also be applied to those spectra.

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4. 1 Measurement Parameter Configuration Screen

When you select <2. Spectrum> in the Mode Selection screen, the measurement parameter configuration screen will be displayed.

The measurement parameter configuration screens differ slightly for the ABS (absorbance) and T% (% transmittance) measurement modes (Fig. 4.1) and for the E (energy) measurement mode (Fig. 4.2).

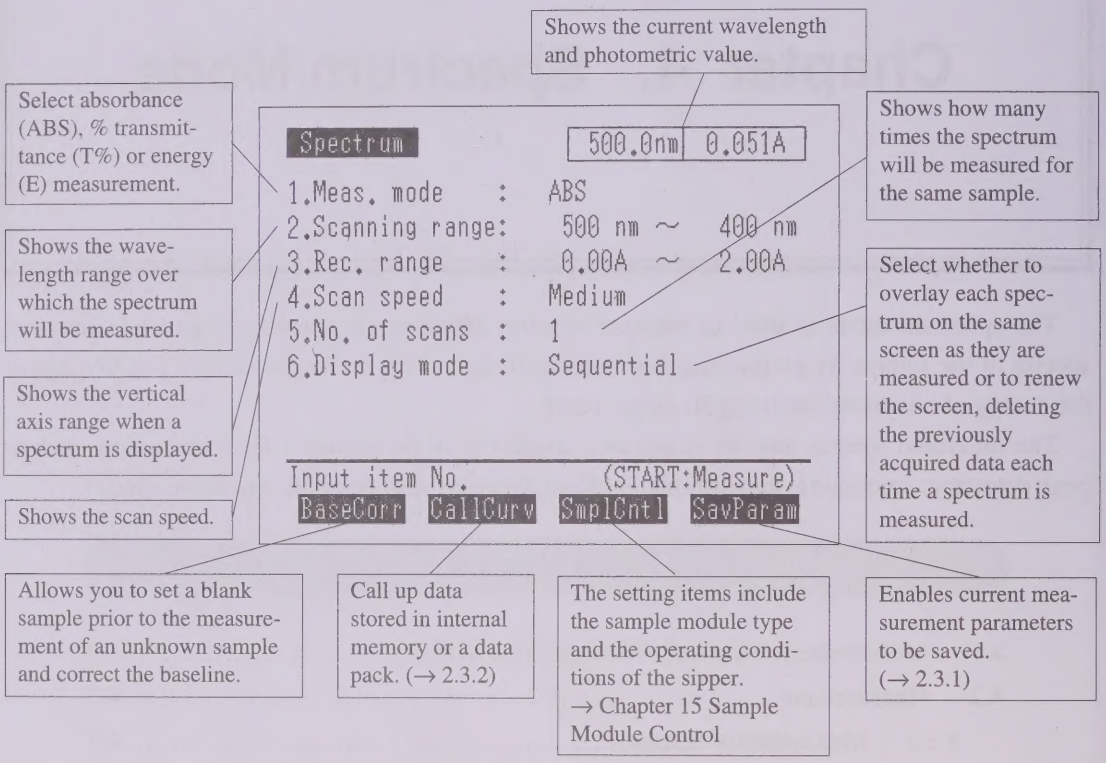

Fig. 4.1 Measurement parameter configuration screen (ABS, T% modes)

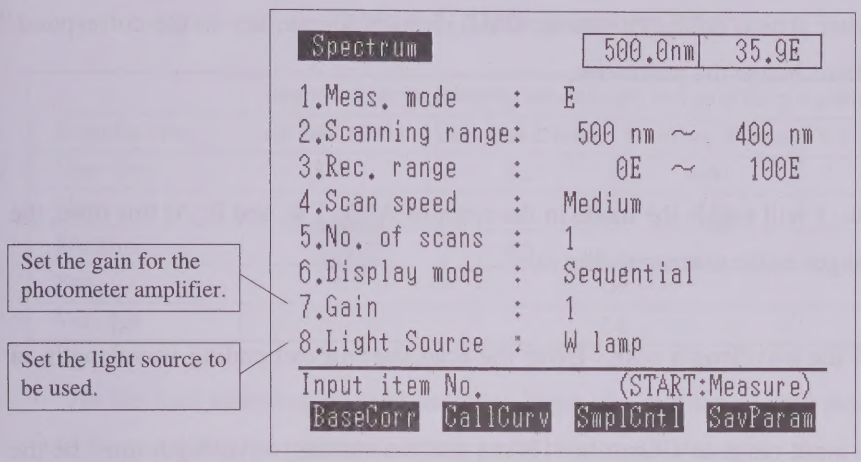

Fig. 4.2 Measurement parameter configuration screen (E mode)

To change a parameter shown on the Parameter Configuration screen, key-in the corresponding item number and then change the parameter.

(1) Meas. mode

Entering item No. 1 will toggle the mode in the order of ABS, T%, and E. At this time, the Rec. range will changes to the corresponding one.

(2) Scanning range

Set the range of the wavelength scan. Enter the scan starting and ending wavelength, in that order.

The wavelength input range is 190nm to 1100nm and the starting wavelength must be the longer wavelength of the two.

The minimum scan range is 1nm.

(Scan start wavelength) - (Scan end wavelength) >= 1nm

(3) Rec. range

Set the range for the vertical axis during spectrum recording. Input ranges are follows;

ABS : –3.99 ~ 3.99

T% E : –3.99 ~ 3.99

(4) Scan speed

To specify a wavelength scanning rate, select one from the five options, Very fast, Fast, Medium, Slow, and Very slow. The data integration time at each rate is shown below:

Very fast and Fast	: 0.05 sec.
Medium	: 0.15 sec.
Slow	: 0.3 sec.
Very slow	: 1.0 sec.

The data sampling interval is determined from the scanning rate (1) and the wavelength range so that the number of data pieces that are scanned by a single run is 1,000 minimum.

Table 4.1 Data sampling interval

	Scanning range (starting wavelength minus ending wavelength)/nm			
Scanning rate	Less than 100 nm	Less than 200 nm	Less than 500 nm	500 nm or more
Very slow	0.1	0.2	0.5	1.0
Slow	0.2		0.5	1.0
Medium	0.5			1.0
Fast	1.0			
Very fast	2.0			

As the data sampling interval becomes larger, the number of data pieces becomes smaller, which means that the practical scanning rate becomes faster.

(5) No. of scans

Set the number of times a scan will be repeated.

If this is set to 2 or more times, the interval setting will be displayed with the scanning repetitions on the same display line.

When you press the (START/STOP) key once, measurement will be repeated only the set number of times.

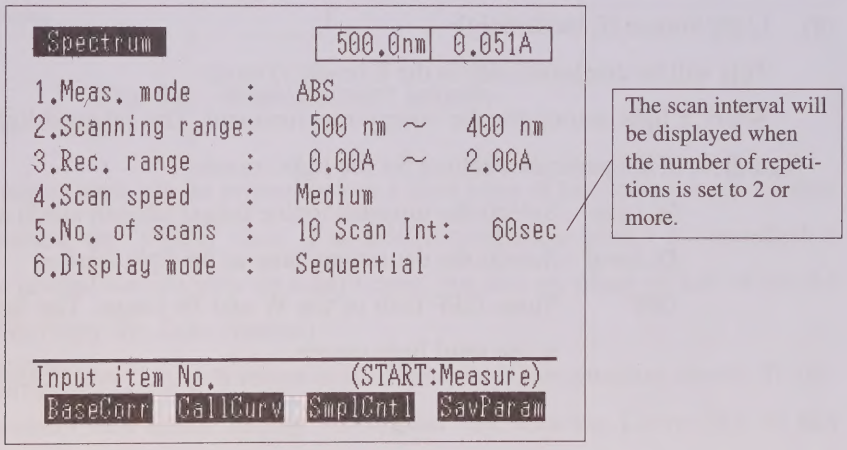

Fig. 4.3 Parameter Configuration screen (when the scanning count is 2 or more))

The scanning interval includes the time required for scanning. If the scanning interval is set to a value longer than the time required for scanning, the UV-1700 will wait for the time equivalent to the difference between the two and then start scanning. During this waiting period, the remaining scanning count and the remaining waiting time are displayed.

If the time required for scanning is actually longer than the scanning interval, the scan will be continuously carried out without any waiting time. In this case, the set value for the scanning interval will be changed to the actually required time.

(6) Display mode

This parameter will toggle between Sequential<->Overlay each time this item is selected.

Sequential : The screen is renewed for each scan and only the spectrum from that measurement is displayed.

Overlay : The screen is not updated with each scanning result. The spectrum display for each scan is left as it is so that multiple spectra are overlaid in the display.

(7) Gain (E mode only)

This will be displayed only in the E (energy) mode.

This sets the gain for the photometer amplifier so that measurement can be performed without saturation of the energy curve.

The minimum setting is 1 and the maximum is 4. Sensitivity is increased by approximately 4 times with each level.

(8) Light Source (E mode only)

This will be displayed only in the E (energy) mode

Select a light source for the energy measurement. The selected light source will be used regardless of the parameter setting for the light source.

W lamp : Selects the tungsten iodine lamp (halogen lamp) as the light source.

D_2 lamp : Selects the deuterium lamp as the light source.

OFF : Turns OFF both of the W and D_2 lamps. The light source mirror turns to the third light source.

4.2.1 Measurement Screen

Set the measurement parameters and then press the (START/STOP) key. The measurement will be started with the measurement screen displayed. To stop the measurement, press the (START/STOP) key again. After the measurement has been finished (stopped), the measurement screen will be as shown in Fig. 4.4.

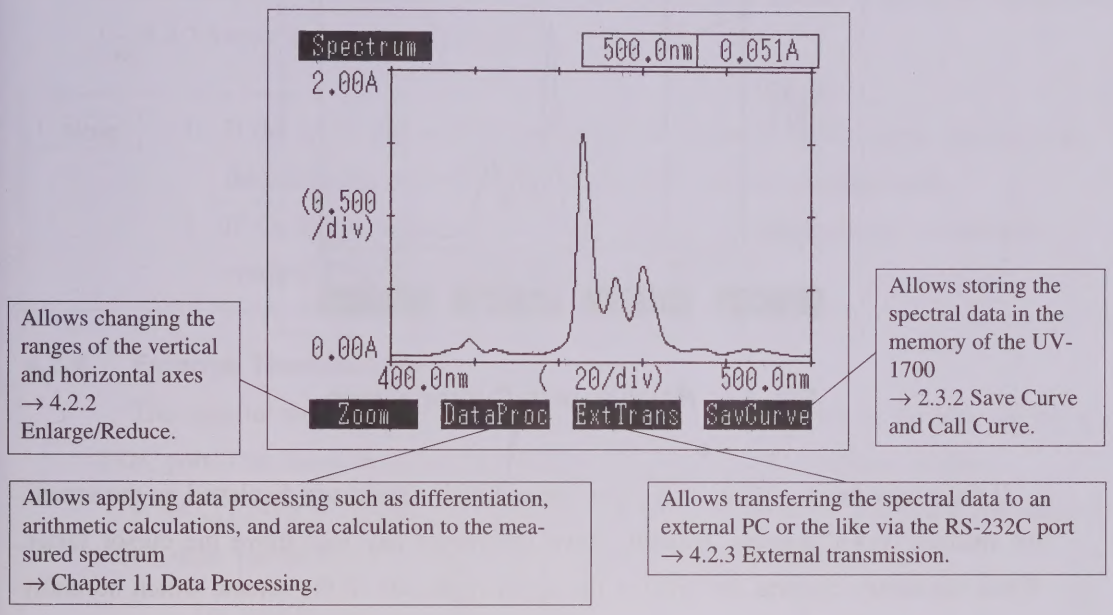

Fig. 4.4 Measurement screen

The measurement result can be printed out as a hard copy of the screen on the printer (optional) by pressing the (PRINT) key. If an ESC/P-compatible printer is connected, a spectrum can be printed out not only on a hard copy, but also on paper of half of the A4 size (→ 2.4 Screen Copy and Data Printout).

Pressing the (RETURN) key will return to the Parameter Configuration screen. To display the measurement data again, display "0:Original" by selecting Curve Call on that screen. In "0:Original", the data immediately after the measurement is included. If the measurement data is overwritten, the last measurement data is included in "0:Original". No previous data can be displayed again.

4.2.2 Reading with Cursor

The data at each wavelength of the spectrum can be read using the cursor.

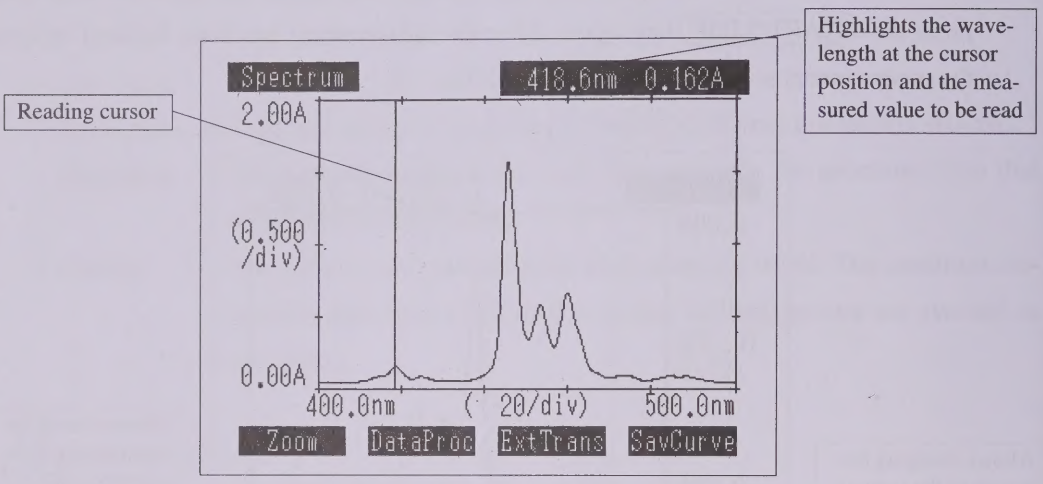

Fig. 4.5 Reading with Cursor screen

If the cursor key (◁ or ▷) is pressed with a spectrum displayed on the screen, the reading cursor appears. Holding down the cursor key will move the cursor faster. When the cursor appears, the field at the upper right part of the screen, which normally indicate the current wavelength and the measured value, is highlighted indicating the wavelength at the cursor position and the measured value.

If any key other than the ◁ , ▷ , and PRINT keys is pressed, the reading cursor disappears. If the recording mode is Overwrite, the wavelength at the cursor position and the measured value are of the last displayed spectrum.

4.2.3 Enlarge/Reduce

The displayed spectrum can be enlarged or reduced by changing the vertical or horizontal axis of the spectrum (only enlarged by changing the horizontal axis).

Press the F1 key with the measurement screen displayed, and then enter values for the upper and lower limits of the vertical axis and the lower and upper limits of the horizontal axis in this order to change the range. If the ◁ or ▷ key is pressed when the lower and upper limits of the horizontal axis are entered, the cursor appears allowing you to enter the horizontal axis values with the cursor.

The enlargement or reduction may be repeated, but the horizontal axis values cannot be made larger exceeding the displayed upper and lower limits. In this case, use the unprocessed data function that is displayed in the place of the (F3) key after the enlargement or reduction has been finished.

If the storage of the curve is selected (by pressing the (F4) key) after the enlargement or reduction has been finished, the enlarged or reduced data can be stored in the memory (→ 2.3.2 Save Curve and Call Curve).

Note

1. If the curve data is overwritten on the screen using the curve call function, the enlargement or reduction is applied to the last displayed data.
2. If the measurement result is overwritten, the enlargement or reduction is applied to the last measurement data.

4.2.4 External Transmission

The spectral data may be transferred to an external computer or the like via the RS-232C port. This function is used to load the data to a personal computer or other.

If the (F3) key is pressed, the data is output as a pair of the wavelength and the measured value via the RS-232C port starting with the long wavelength side.

The data format is as shown below:

Absorbance	ZZZZ.Z □ □ SX.XXXY [CR] [LF]
Other than absorbance	ZZZZ.Z □ □ SXXX.XY [CR] [LF]

Z is wavelength, X and Y the measured values, and □ the blank space code. S indicates the sign for the measured values. When the measured value is negative, S is - (negative). When positive or 0, the blank space code is output. Y is only output when the number of displayed digits of data is 5 in the utilities menu screen. The CR(0Dh) and LF (0Ah) codes are output for each pair of data pieces.

At the end of the data, the SB (1Ah) code is output.

The transmission specification for the RS-232C port is as follows:

Baud rate	: 9,600 bps
Data bit length	: 7
Stop bit	: 1
Parity	: Odd number
X parameter	: None

For the connection cable, see "14.1 Connecting to a PC" of Chapter 14.

Note The external transfer function is used to mono-directionally transfer data from the UV-1700 to an external personal computer. This transfer continuously occurs at a rate assuming that the data will be loaded to the personal computer. The data is output at intervals of nearly 20 ms via the RS-232C port. This rate is good enough for almost every personal computer to receive the data. However, some personal computers of a low processing rate might fail to receive the whole data. If the transferred data is to be printed out by connecting a printer with small capacity of its internal buffer via the RS-232C port, all of that data might not be printed out.

Chapter 5. Quantitation Mode

The quantitation mode is used to quantify an unknown sample by creating a calibration curve from the standard sample. The following four types of measurement methods are available according to the number of wavelengths used:

- One-wavelength method: The sample is quantified using its absorbance at a single wavelength. The operation procedures in this chapter mainly describe this method.
- Two-wavelength method: The absorbance at a wavelength other than the quantitation wavelength is used to eliminate the interfering components and contaminants (→ 5.4.1 Two-wavelength Quantitation Method).
- Three-wavelength method: The absorbance of two wavelengths are used to eliminate the interfering components (→ 5.4.2 Three-wavelength Quantitation Method).
- Derivative quantitation: The derivative value (1st through 4th orders) for the spectrum at the quantitation wavelength is used (→ 5.5 Derivative Quantitation).

The calibration curve is created using one of the following three methods:

- K factor method: In the equation, "concentration = K x absorbance + B", K and B are predetermined.
- Single-point calibration curve method: One standard sample is measured to create the calibration curve.
- Multi-point calibration curve method: Multiple standard samples (10 maximum) are measured to create the calibration curve.

If the measurement is repeated, the measurement results may be displayed as a list. A single list allows including a maximum of 182 measurement results. This data may be stored as a single file in the memory.

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5.1 Measurement Parameter Configuration Screen

When you select <3. Quantitation> in the mode selection screen, the measurement parameters configuration screen in Figure 5.1 will be displayed.

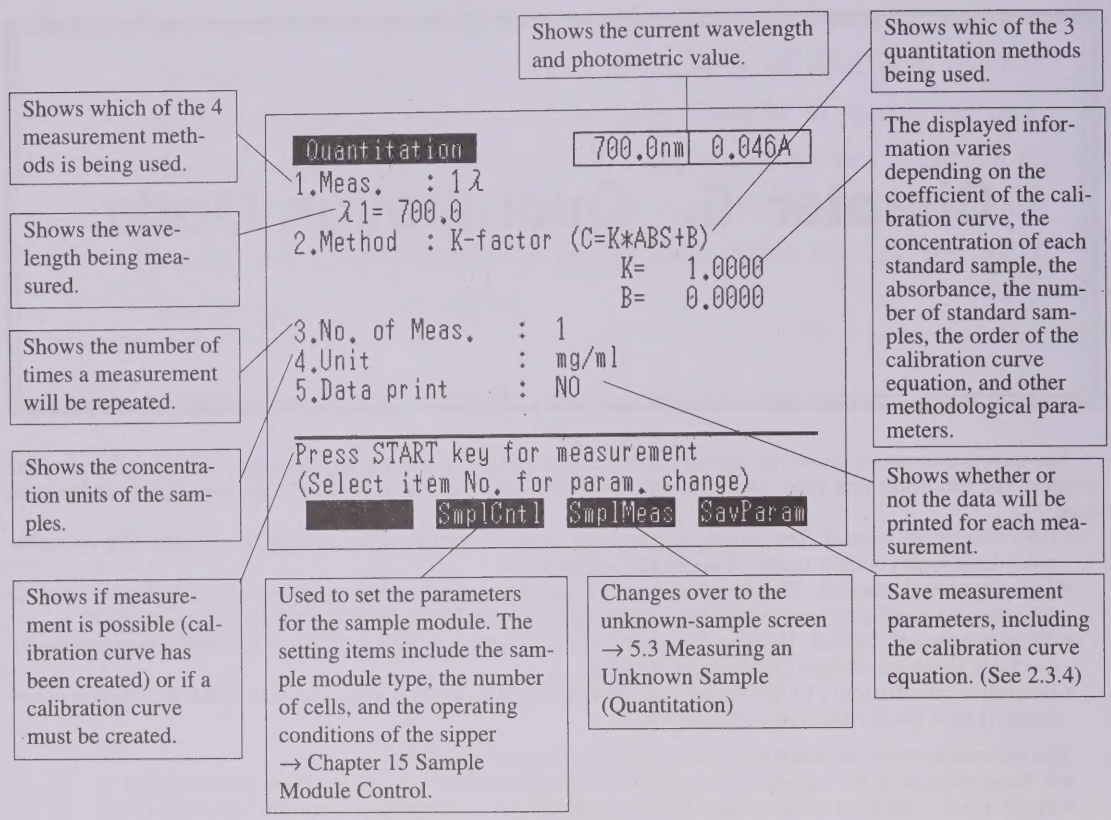


Fig. 5.1 One-wavelength quantitation

Set the various measurement parameter items in a dialogue format. Select the parameter to be set by entering the item number.

(1) Meas. (Measurement method)

The measurement method selection screen is shown in Figure 5.2.

Select the measurement method from the following 4 types and then enter the measurement wavelength as instructed on the screen.

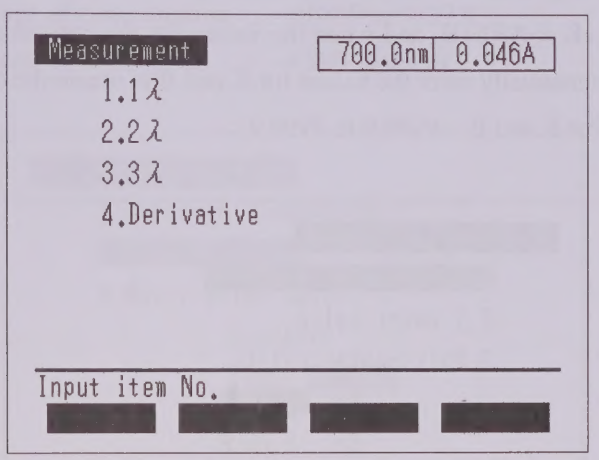


Fig. 5.2 Measurement method selection screen

<1. 1 λ>

Enter measurement wavelength λ_1.

<2. 2 λ>

Enter measurement wavelengths $\lambda_1$and λ_2. λ_2 is the quantitation wavelength and λ_2 the wavelength at which to eliminate the interfering components (→ 5.4.1 Two-wavelength Quantitation Method)

<3. 3 λ>

Enter measurement wavelengths λ_1, λ_2 and λ_3. λ_2 is the quantitation wavelength, and λ_1 and λ_3 the wavelengths at which to eliminate the interfering components. The entered wavelength values are automatically arranged as λ_1, λ_2, and λ3 in this order starting with the longer wavelength side (→ 5.4.2 Three-wavelength quantitation method).

<4. Derivative>

Enter the measurement wavelength λ_1 and the order of derivative.

(See 5.5 Derivative Quantitation Method)

(2) Method (Quantitation method)

Select one of the following three quantitation methods and then set the parameters according to the instructions given on the screen. When the single-point calibration curve or the multi-point calibration curve is selected, measure the standard sample for creating the calibration curve before measuring an unknown sample.

- K-factor

The relationship between the concentration C and absorbance ABS of a sample is expressed as C=K × ABS+B, and when the values for the constants K and B are already known, you can manually enter the values for K and B to create the calibration curve.

Input range for K and B: –9999.9 to 9999.9

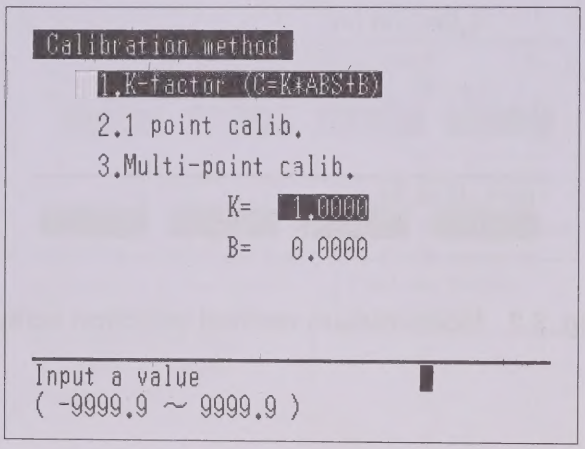


Fig. 5.3 Setup screen for calibration curve (K factor method)

- Single point calibration curve method

This will measure the concentration of an unknown sample by finding the value for K in the calibration curve equation C=K × ABS from a single standard sample of known concentration. The calibration curve will be a straight line defined by the origin and the absorbance and concentration of the standard sample. The created calibration curve can be reviewed by pressing the (F1) key on the Parameter Configuration screen.

If the single-point calibration curve is selected on the Calibration Curve Selection screen, the Setup screen for calibration curve method appears (Fig. 5.4).

After entering the concentration, specify the absorbance by either of the following two methods:

1) Keying-in method

   Enter a value using the sheet keys.

2) Measurement input method

   Set the standard sample in the cell holder and then press the (START/STOP) key.

Input range of concentration : –9999.9 to 9999.9

Input range of absorbance : –9.999 to 9.999

```
Calibration method
    1.K-factor (C=K*ABS+B)
    2.1 point calib.
    3.Multi-point calib.
              Standard
              Conc= 1.0000
              ABS =  1.000

Input Conc. value
( -9999.9 ~ 9999.9 )
```

Fig. 5.4 Setup screen for calibration curve (single-point calibration curve method)

If the repetition count is set to more than one in the measurement input, the measurement will be repeatedly performed and the mean value of absorbance will be used.

Fig. 5.5 shows the Standard Sample Meas. screen. In the right column of the screen, the measured value at each measurement run is displayed. After the measurement has been repeated to the specified repetition count, the mean value is calculated and then displayed as "m".

```
Std.Tabl                                  700.0nm  0.046A
No.  Conc.   ABS        No.   ABS
 1   10.000             1     0.046
                        2     0.046
                        3
                        m
Set standard, then press START
```

Fig. 5.5 Standard Sample Meas. screen (single-point calibration method)

- Multi-point calibration curve method

  Set the parameters for creating the calibration curve from multiple standard samples of known concentrations. A linear, quadratic, or cubic equation can be used as the calibration curve equation. Enter the number of standard samples, the order of the calibration curve equation, and the zero intercept conditions according to the messages appearing on the screen.

  The required number of standard sample is equal to or larger than the order of the calibration curve equation when "0 Intercept" is set to YES, or equal to or larger than the order of the calibration curve equation plus 1 when "0 Intercept" is set to NO.

  Number of standard samples : 1~10
  Order : 1~3
  Zero intercept : YES/NO

  When the parameters are set completely, the UV-1700 returns to the Parameter Configuration screen.

```
Calibration method
    1.K-factor (C=K*ABS+B)
    2.1 point calib.
    3.Multi-point calib.
                No.of Std.= 5
                Order =  1
                0 intercept:  YES

Input order
( 1 ~ 3 )
```

Fig. 5.6 Setup screen for calibration curve (multi-point calibration curve method)

(3) No. of Meas. (Repetition count)

Specify how many times the same sample is to be measured. If the repetition count is set to more than one, the measurement will be performed as follows:

Measurement of standard sample : The measurement is repeatedly performed and the mean value for absorbance is used.

Measurement of unknown sample : The measurement is repeatedly performed and both the measured values and mean value are displayed.

To abort the repeating measurement, press the (RETURN) key. In this case, the mean value will not be calculated.

Note	If a multi-cell or similar holder is used with the number of cells set to more than one, the repeating measurement function takes priority. The interlocked measurement of multiple cells cannot be carried out.

Input range of repetition count : 1~9

(4) Unit

Specify the concentration unit for the quantitation result by entering one of the following numbers:

0: None, 1: %, 2: ppm, 3: ppb, 4: g/*l*, 5: mg/m*l*, 6: ng/m*l*, 7: M/L, 8: μg/m*l*

(5) Data print

Specify whether or not the data is output to the printer (optional) whenever each measurement run is completed. If this parameter is set to YES, the data will be printed out on the printer after each measurement run.

(6) Baseline correction (for the two-wavelength, three-wavelength, or derivative quantitation method)

The baseline is corrected in the wavelength range specified in the measurement wavelengths. To perform the quantitation by the two-wavelength, three-wavelength, or derivative quantitation method, set the blank sample on the cell prior to the measurement, and then correct the baseline. To abort the correction, press the (START/STOP) key.

5.1.1 Save Calibration Curve

A calibration curve can be saved to memory at the same time that the other measurement parameters are saved using the [Sav Param] function in the parameter configuration screen.

(See 2.3.1 Save Parameters)

A saved calibration curve can be recalled at the same time as the other measurement parameters using [Params] in the mode selection screen.

(See 2.1.1 Load Parameters)

5. 2 Creating Multi-point Calibration Curve

If the multi-point calibration curve is selected for the calibration curve method among the measurement parameters, the calibration curve must be created before an unknown sample is measured. The calibration curve equation may be stored as a parameters file like other parameters. It is, therefore, possible to call it using the parameter call function ((F1) key) via the Mode Selection screen.

When the (START/STOP) key is pressed with the Parameter Configuration screen displayed, the screen for entering concentration of standard sample (concentration table) appears.

5.2.1 Entering Concentrations

Key in the concentration of standard samples (STD). Their concentrations can be entered at random regardless of which one is larger or smaller.

When the concentrations of all the standard samples are entered, the screen for entering absorbance appears.

```
Std.Tabl                          700.0nm  0.045A
No.  Conc.     ABS          No.  ABS
1    0.0000                 1
2    10.000                 2
3                           3
4
5

Input Conc. value
( -9999.9 ~ 9999.9 )  Standard No. =3
```

Fig. 5.7 Concentration table (entering concentrations)

5.2.2 Entering Absorbance

Specify the absorbance (ABS) of each standard sample (STD) by selecting one of the following three methods:

1) Keying-in

   Enter a value for ABS.

2) Measurement input (cell 1 only)

   Set the standard samples on the multi-cell holder (optional) in the order of having entered their concentrations starting with cell 1, and then press the (START/STOP) key.

3) Multi-cell sequential measurement input

Each cell will be automatically selected to carry out the measurement. In this case, the maximum number of standard samples varies depending on the multi-piece cell used:

6 cells multi-cell, CPS-240A : 6 max.

8 cells multi-cell : 8 max.

16 cells multi-cell : 10 max.

If the repetition count is set to more than one in 2) measurement input, the measurement will be performed repeatedly and the mean value for absorbance will be used.

Fig. 5.8 shows the Standard Sample Measurement screen, on which the measured value at each measurement run is indicated in the right column. After the measurement has been completed to the specified repetition count, the mean value is calculated and then displayed as m.

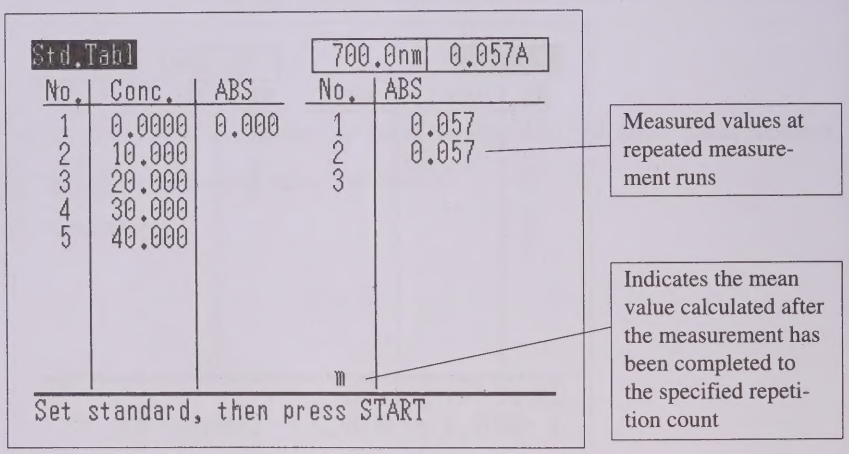


Fig. 5.8 Standard Sample Measurement screen (multi-point calibration method)

5.2.3 Concentration Table

After the input of absorbance has been completed, the Concentration/ABS Data screen (Fig. 5.9) appears. This screen allows you to review the calibration curve by pressing the (F1) key.

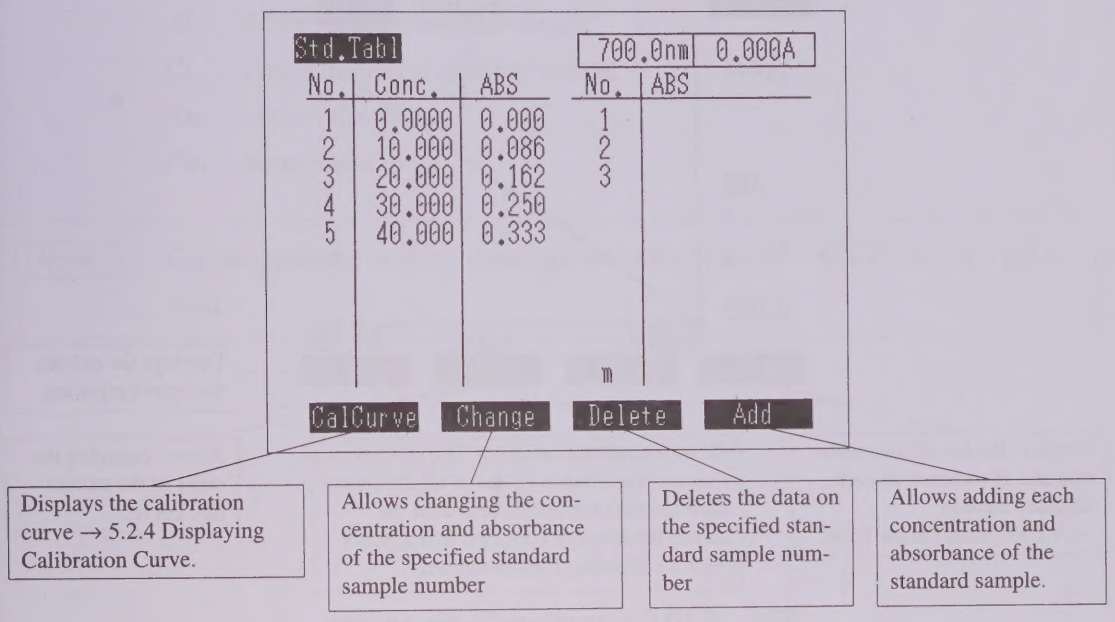


Fig. 5.9 Concentration/ABS Data screen

5.2.4 Displaying Calibration Curve

The calibration curve can be reviewed on the Concentration Table screen or the Parameter Configuration screen.

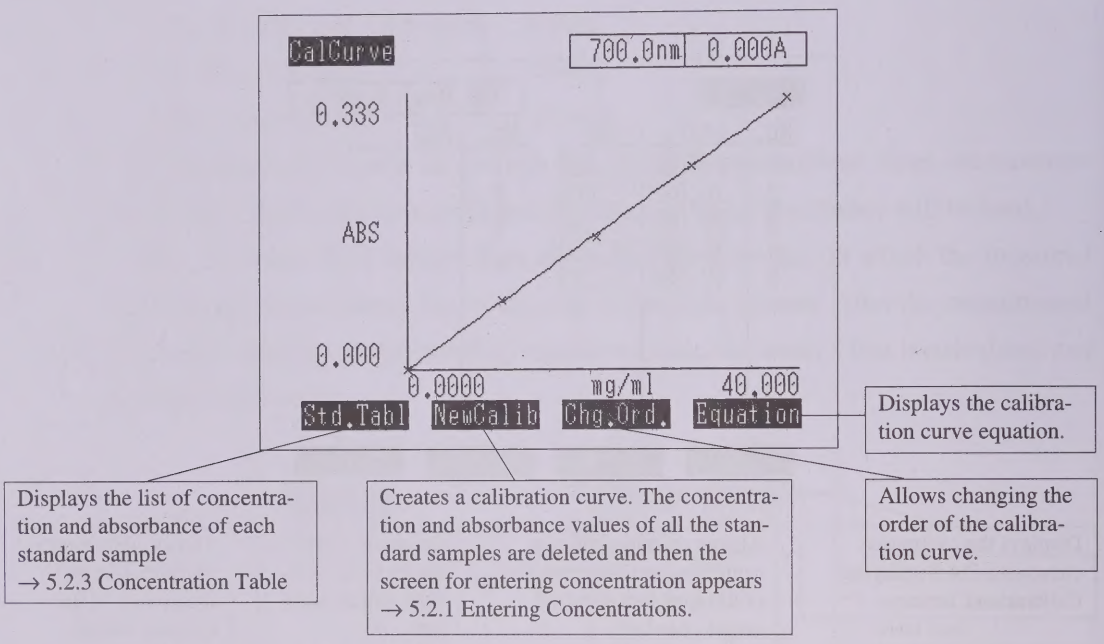


Fig. 5.10 Calibration Curve screen

Fig. 5.11 shows the screen on which the equation has been displayed.

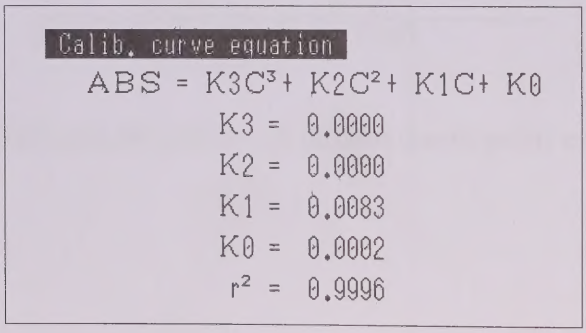


Fig. 5.11 Calibration Curve screen

The correlation coefficient r^2 is obtained using the following equation (only when there is no zero intercept):

$$r^2 = \frac{\{\Sigma(Ai-Am)(Ci-Cm)\}^2}{\{\Sigma(Ai-Am)^2\}\{\Sigma(Ci-Cm)^2\}}$$

where

Ai : Absorbance of standard sample

Ci : Concentration of standard sample

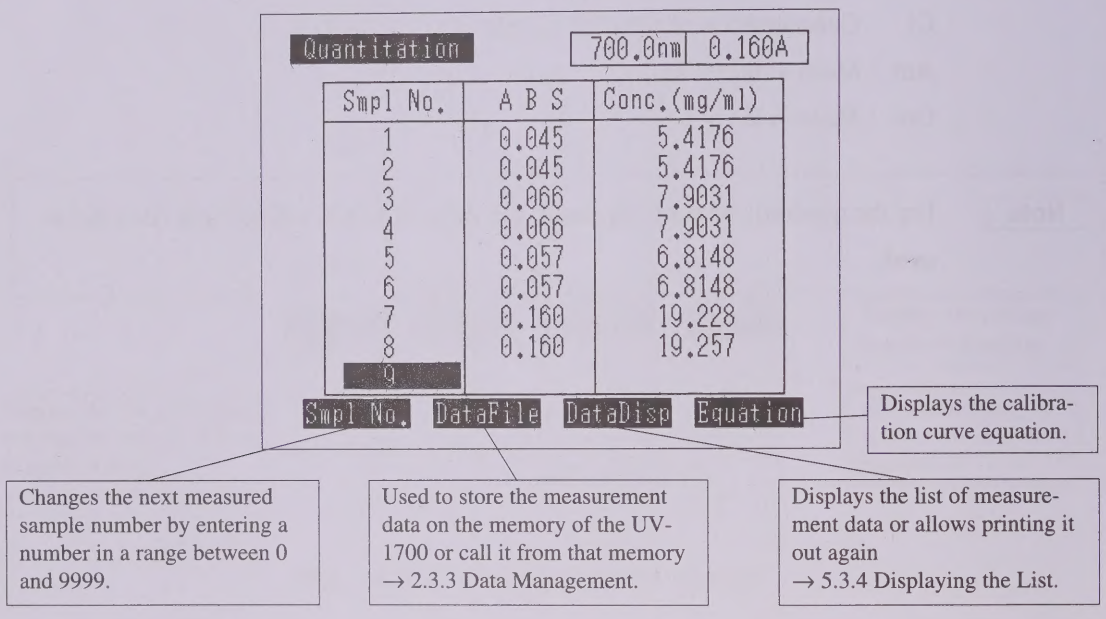
Am : Mean value of Ai

Cm : Mean value of Ci

Note For the quadratic or cubic equation, the value of $K3Ci^3 + K2Ci^2 + K1Ci + K0$ is used.

5.3.1 Measurement Screen

After the calibration curve has been created successfully, an unknown sample can be measured. Press the (F3) key [DataDisp] or the (START/STOP) key with the Parameter Configuration screen displayed. The measurement screen will appear (Fig. 5.12). If the (START/STOP) key is pressed, the first measurement run will be carried out.



No.	ABS	mg/ml
1	0.045	5.4176
2	0.045	5.4176
3	0.066	7.9031
4	0.066	7.9031
5	0.057	6.8148
6	0.057	6.8148
7	0.160	19.228
8	0.160	19.257

Fig. 5.12 Measurement screen and printout sample

5.3.2 Displaying the List

As the measurement is repeated, the measurement screen will be scrolled while displaying only the latest eight measurement results. The list display function is used to display the list of the measurement data. This screen also provides the function of printing out or deleting all of the data.

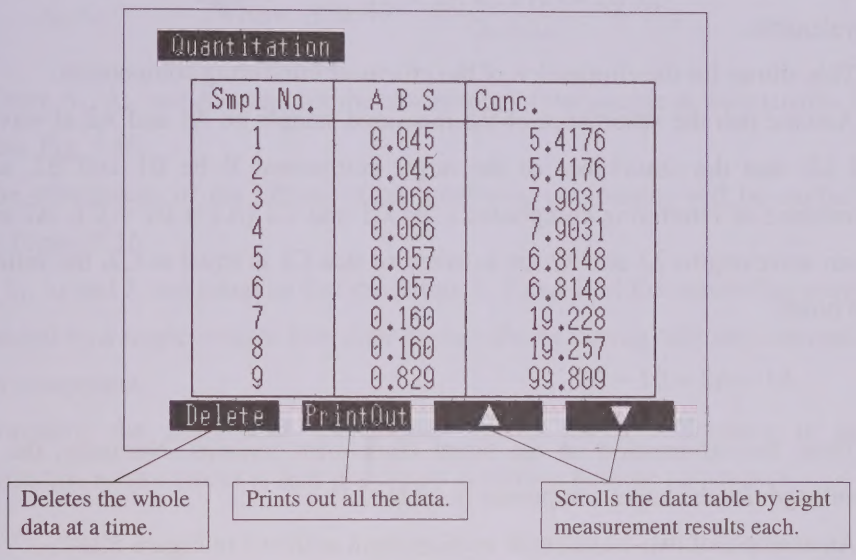


Fig. 5.13 List Display screen

No.	ABS	mg/ml
1	0.045	5.4176
2	0.045	5.4176
3	0.066	7.9031
4	0.066	7.9031
5	0.057	6.8148
6	0.057	6.8148
7	0.160	19.228
8	0.160	19.257
9	0.829	99.809
10	0.829	99.897
11	1.064	128.18
12	1.064	128.18

Fig. 5.14 Sample of data printout

5.4 Two/Three-wavelength Quantitation Method

This is an accurate quantitation method which can be used to eliminate the effects of dispersion due to interfering components and contaminants and in correcting "floating" of the baseline due to bubbles when such conditions exist.

5.4.1 Two-wavelength Quantitation

This method quantitates based on the difference between the photometric values at two wavelengths.

This allows for the elimination of the effects of interfering components.

Assume that the absorbance of the measured sample be A1 and A2 at wavelengths λ1 and λ2, that the absorbance of the target component B be B1 and B2, and that the absorbance of interfering component C be C1 and C2 (A1 = B1 + C1, A2 = B2 + C2). When wavelengths λ1 and λ2 are selected so that C1 is equal to C2, the following equation holds:

$$A1 - A2 = B1 - B2$$

Thus, the information on the target component remains. Normally, the absorbance wavelength for the target component is set for λ1.

An example of two-wavelength measurement is shown in Figure 5.18.

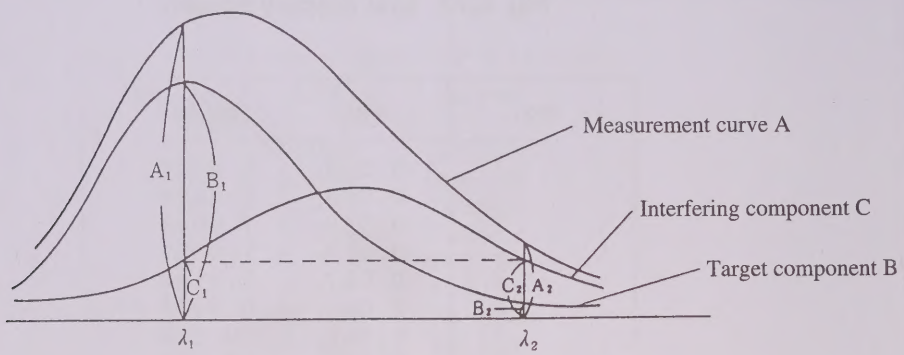


Fig. 5.15 Schematic diagram of two-wavelength quantitation

Quantitation measurement is then performed according to these parameters.

5.4.2 Three-wavelength Quantitation

Three-wavelength computation also eliminates the effects of interfering components, while also being useful in eliminating "floating" of sloped baselines due to dust, etc.

The following calculation is performed based on the photometric values at three wavelengths.

$$A_2\text{-}A_4 \qquad \left(\text{Where, } A_4 = \frac{(\lambda_1 - \lambda_2)\,A_3 + (\lambda_2 - \lambda_3)\,A_1}{\lambda_1 - \lambda_3}\right)$$

Where A_1, A_2, and A_3 stand for the absorbance of the sample at wavelengths λ_1, λ_2, and λ_3. (See Fig. 5.16)

The elimination of the effects of an interfering component will be explained below using Figure 5.16.

If λ_1, λ_2 and λ_3 are taken so that the points S, T and U of the interfering component are connected by a single straight line, then $A_2\text{-}A_4 = B_2\text{-}B_4$ leaving only the information for the target component.

Normally, the absorbance wavelength for the target component is set for λ_2. Quantitation measurement is then performed according to these parameters.

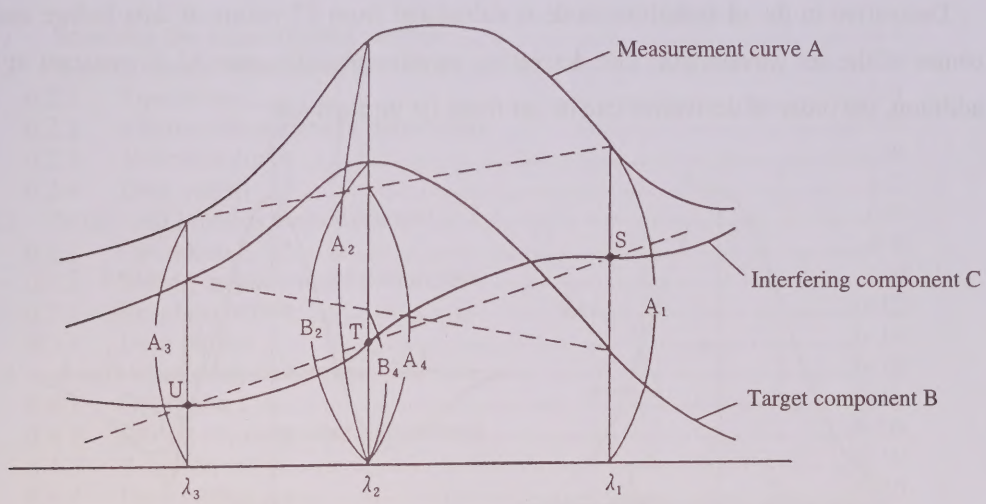


Fig. 5.16 Schematic diagram of three-wavelength quantitation

5.5 Derivative Quantitation Method

This method of quantitation uses the derivative value at a set wavelength(s). Derivative quantitation has the following advantages.

(A) Absorption bands can be recognized when there are two or more absorption bands overlapping at the same wavelength or at slightly different wavelengths.

(B) Weak absorption bands which are hidden in portions where the absorbance increases sharply relative to wavelength.

(C) The single greatest point of absorption can be recognized in broad absorption spectra.

(D) Since a straight line correlation can be drawn between the derivative value and the concentration, quantitative analysis becomes simpler in the presence of a background.

The 2nd derivative spectrum in a case where two absorption bands overlap at different wavelengths is shown in Figure 5.17. (a) is the normal spectrum, where the absorption band B cannot be discerned in the spectrum A+B in which the absorption bands A and B are overlapped. The 2nd order derivative of this is shown in (b), where the spectrum A+B is obtained by the combination of the derivatives of absorption bands A and B. Thus, the absorption band B, which was hidden in the larger absorption band A, can clearly be discerned in the 2nd derivative.

Refer to "11.3 Derivative Processing Smoothing Processing (Derivative)" for details on derivative calculations.

Derivative in the quantitation mode is calculated from 17 points of data before and after the center of the set wavelength. The derivative wavelength difference $\Delta\lambda$ is constant at 0.8nm. In addition, the order of derivative can be set from 1st through 4th.

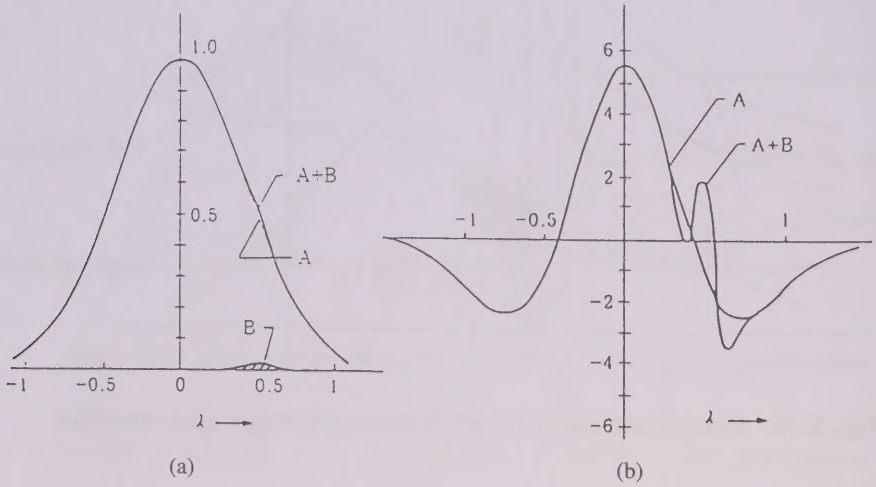


Fig. 5.17 2nd derivative spectrum with two absorption bands - Overlapping at different wavelengths -

Chapter 6. Kinetics Mode

The Kinetics mode allows you to measure the changes in the absorbance (ABS), which occur over time from the enzyme reaction and to obtain the activity value of the enzyme from that measurement result.

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6. 1 Selecting the measurement method

When the 4. Kinetics is selected from the mode selection screen, the following measurement method selection screen will be displayed (Fig. 6.1.1).

```
Kinetics

1. 1cell kinetics(1 λ)
2. Multi-cell kinetics(1 λ)
3. 1cell kinetics(2 λ)
4. Rate mode

Input item No.
```

Fig. 6.1.1 Measurement method selection screen

Four kinds of measurement methods are contained in Kinetics mode. Each measurement method is as follows:

(1) 1 cell kinetics measurement (1λ)

This is a mode for measuring enzyme activity value from the change in time of one wavelength absorbance.

(2) Multi-cell kinetics measurement (1λ)

When used together with special accessories such as multi-cell, CPS-240 and micro multi-cell, this mode permits simultaneous measurement of the change in time of absorbance of up to a maximum of 16 cells to obtain enzyme activity values. This is the measurement of one wavelength.

(3) 1 cell kinetics measurement (2λ)

In this mode, enzyme activity values are measured from the change in time of the difference of two wavelength absorbance.

(4) Rate measurement

In this mode, enzyme activity values are measured from the change in time of 1 cell absorbance just as (1). However, this mode is the successive display mode to display the change in successive absorbance in numerical values.

6. 2 1 cell kinetics measurement (1λ)

6.2.1 Operation

In the 1 cell kinetics measurement mode, it is possible to display the change in time of absorbance on the screen and obtain the change in absorbance quantity of an interval set by the lag time and rate time by calculating it is the change in quantity per minute.

Fig. 6.2.1 shows the relation between the change in time of absorbance and the lag time and rate time. Linear regression of the sampling data between the rate time is carried out by the method of least squares to obtain the rate of change (Δ Abs/min).

Activity values are obtained by multiplying the range of change by four factor values.

(Activity value) = (Factor 1)×(Factor 2)×(Factor 3)×(Factor 4)×(Rate of change)

Activity values are displayed in the range from –9999.9 to 9999.9.

If this range is exceeded, ##### will be displayed. If the range is exceeded, change the set values of the factor and re-calculate them on the data table screen. If it is possible to predict the exceeded range, adjust the factor values and take the measurement again.

The initial value is the absorbance when measurement is started.

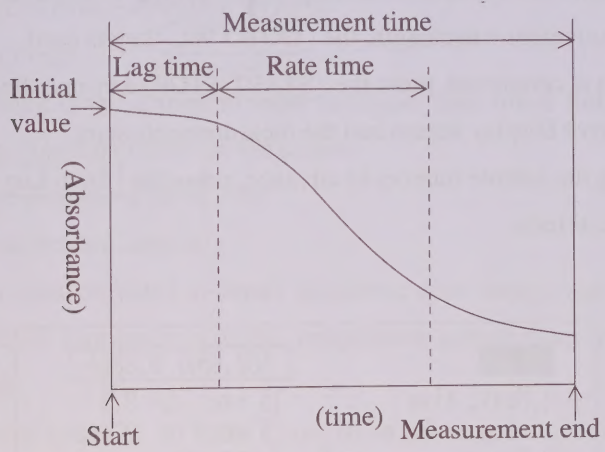

Fig. 6.2.1 Lag time and rate time

Data sampling intervals will be different depending on measurement time. (Table 6.2.1)

Table 6.2.1 Measurement time and sampling intervals

Measurement time	Sampling interval
1 ~ 100	0.1
101 ~ 200	0.2
201 ~ 500	0.5
501 ~ 1000	1.0
1001 ~ 2000	2.0
2001 ~ 5000	5.0
5001 ~ 6500	10.0

6.2.2 Setting measurement parameters

Parameters displayed on the Measurement Parameters screen can be changed by entering the number of the item using keys. Interactive method is the same as that of the main unit of spectrophotometer.

Fig. 6.2.2 shows the Parameters Setting screen for the 1 cell kinetics measurement. For setting the measurement wavelength, the (GOTO WL) key is used.

When setting is completed, press the (START/STOP) key and the screen will change to the Reaction Curve Display screen and the measurements start.

When setting the sample number in advance, press the [Data List] (F2) key and set it on the data table screen.

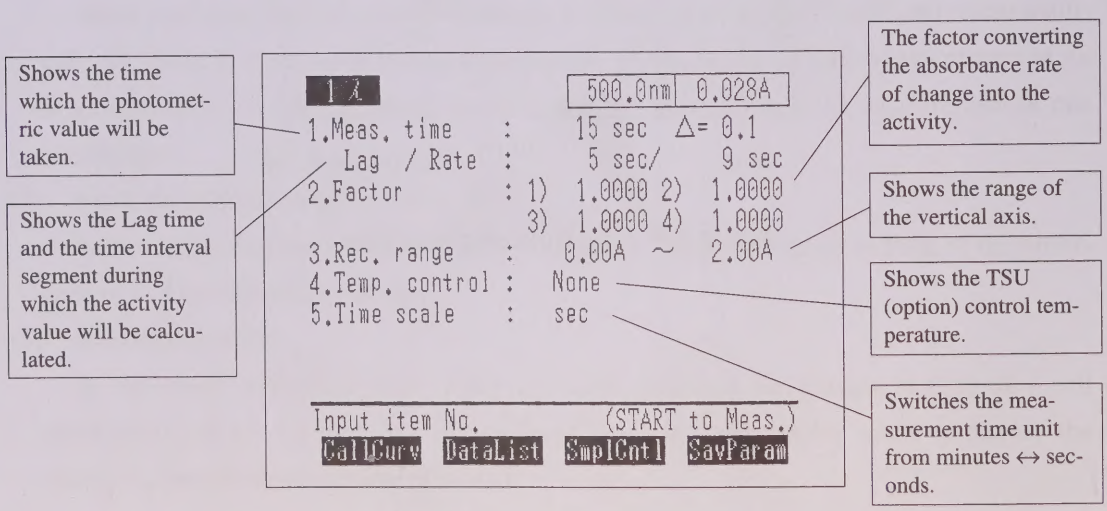

Fig. 6.2.2 Parameters setting screen (1 cell kinetics (1λ))

Explanation of setting items

1. Measurement time and lag/rate

To set the measurement time, enter the total time to obtain actual absorbance data values. Lag indicates the lag time. After the measurement is started, an interval which is not used for activity value calculation is input by the time from when the measurement is started. Rate indicates the rate time and is used to input the time for activity value calculation immediately after the lag time. The time combining the lag and rate cannot exceed the measurement time.

(Measurement time) ≧ (Lag) + (Rate)

Input range is 1 to 6500 for the measurement time, 0 to 6490 for the lag, and 1 to (measurement time) – (lag) for the rate.

2. Factor

The factor is a coefficient used to connect the rate of change of absorbance in terms of the activity value. Four kinds of factors are set respectively. The relation between them is as follows:

(Activity value) = (Factor 1)×(Factor 2)×(Factor 3)×(Factor 4)×(Rate of change)

Input range is from –9999.9 to 9999.9.

3. Recording range

The recording range is used to input the upper limit/lower limit of the Y-axis when displaying the Reaction Curve on the screen.

Input range is from –3.99 to 3.99.

4. Sample temperature control

This is an item provided to install electronic cold energy type temperature control sipper TSU-2200 (optional) to enable temperature setting from the main unit of spectrophotometer.

Setting items are 25°C, 30°C, 37°C and None (no temperature control), a total of four items.

5. Time unit

The unit of time can be changed by (minute) and (second). When the key is pressed, the unit of time of the item 1 is changed from min to sec and vice versa.

CallCurv

(F1) : Pressing this function key enables to call on the screen the curve data stored in the memory of the main unit or the data pack (optional). When the reaction curve is recalled, the activity value is calculated by the factor value set on the parameters setting screen with respect to the recalled waveform data, and the results will be displayed.

DataList

(F2) : When this function key is pressed, the Data Table screen will be displayed. Measurement results (sample number, initial value (ABS), Δ A/min, activity value) will be tabulated. (See 6.6 Data list.)

SmplCntl

(F3) : When this function key is pressed, the sample compartment to be used or parameters of the sample compartment will be set. (See Chapter 15 "Sample Module Control".)

SavParam

(F4) : When this function key is pressed, it is possible to save the current measurement parameters in the memory of the main unit or the data pack (optional).

(See 2.3.1 Save Parameters.)

6.2.3 Reaction curve

After measurement, measurement results are displayed in the data table and the screen will be changed to one showing the reaction curve. The dotted line as shown in Fig. 6.2.3 indicates the calculation interval of the activity value (the end of lag time and the end of rate time).

In this screen, pressing the cursor key (◁ , ▷) will display the cursor, and the time and absorbance of the cursor position can be read. Cursor can be moved by the cursor key.

When a printer (optional) is connected, measurement results displayed on the data table will be printed every time measurement is completed. Fig. 6.2.4 shows the example of printed measurement results.

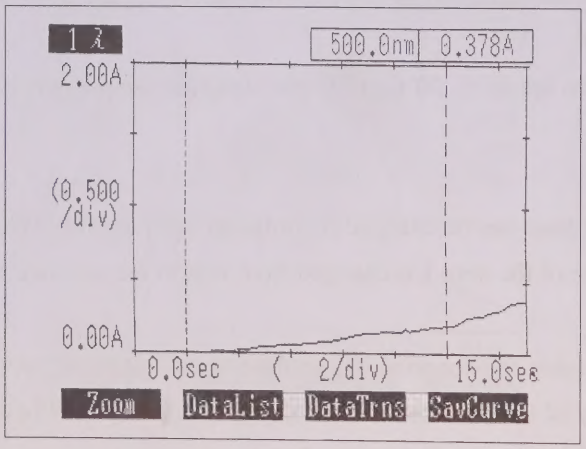

Fig. 6.2.3 Reaction curve screen (1 cell kinetics (1λ))

No.	Init.ABS	dA/min	Activ.
1	0.124	0.3187	0.6374
2	0.027	0.1870	0.3741
3	0.027	0.1870	0.3741
3-1	0.027	0.1781	0.3561

Fig. 6.2.4 Example of printed measurement results (1 cell kinetics (1λ))

Zoom

(F1) : Changing the range of Y-axis and X-axis of displayed reaction curve enables zooming of the reaction curve. After execution, this function returns to the Restore enables the status to return to one before zooming.

Data are available per sampling only. When a value of the X-axis (time axis) is input at a point other than the sampling point, the nearest sampling point including the input time is replaced with the input value of the X-axis and displayed. For sampling intervals, see Table 6.2.1.

DataList

(F2) : Pressing this function key changes the screen to one showing the data table. Measurement results (sample number, initial value (ABS), Δ A/min, activity value) will be displayed in tabular format. (See 6.6 Data list.)

DataOutput

(F3) : When this function key is pressed, the time and absorbance value per sampling point of reaction curve will be output on the printer (optional) or the RS-232C port. (See 6.2.4 Data Output.)

SavCurv

(F4) : When this function key is pressed, it is possible to save the reaction curve in the memory of the main unit or the data pack (optional). It is also possible to recall the reaction curve. When the reaction curve is recalled, the activity value is calculated by the factor value set in the Parameters Setting screen with respect to the recalled waveform data and the results will be displayed.

6.2.4 Data output

With this function key, it is possible to output the time and absorbance value per sampling point of reaction curve will be output on the printer (optional) or the RS-232C port.

An example of output to the printer of the format 1 is shown in Fig. 6.2.5. The same

display of character-string will also be output simultaneously on the RS-232C port.

The format 2 (RS-232C) will not be outputted to the printer. Time and absorbance will be output in pairs to the RS-232C port excepting the header and data number of the format 1.

No.	Time(sec)	ABS
1	0.0	0.027
2	0.1	0.027
3	0.2	0.027
4	0.3	0.027
5	0.4	0.027
6	0.5	0.027
7	0.6	0.027
8	0.7	0.027
9	0.8	0.028
10	0.9	0.028
11	1.0	0.028
12	1.1	0.028
13	1.2	0.027
14	1.3	0.027
15	1.4	0.027
16	1.5	0.027
17	1.6	0.028
18	1.7	0.028
19	1.8	0.028
20	1.9	0.028
21	2.0	0.029

Fig. 6.2.5 Example of printed output format 1 (1 cell kinetics (1λ))

6. 3 Multi-cell kinetics measurement (1λ)

6.3.1 Operation

In the multi-cell kinetics measurement mode, multi-cell (optional), micro multi-cell (optional) and CPS-240 (optional) are used to measure simultaneously the change in time of absorbance of a plurality of samples and to display the results on the screen.

Obtain the change in absorbance of an interval set by lag time and rate time by calculating it in terms of the change in quantity per minute. The method for obtaining the rate of change and that for calculation of activity value are the same as those of the 1 cell kinetics.

Unlike the case of using one sample, when the measurement time is set, the number of measurements and cycle will be displayed. The number of measurements is used to set the number of measurements with respect to one sample, and the cycle is the time from when one sampling of each sample is completed to the next sampling. In other words, it is expressed as follows:

$$\text{(Measurement time)} = \text{(Cycle)} \times \{\text{(No. of measurements)} - 1\}$$

Activity value is displayed in a range from –9999.9 to 9999.9. If this range is exceeded, ##### will be displayed. If this range is exceeded, change the factor set value and re-calculate on the screen of data table. When it is possible to predict that the range will be exceeded, adjust the factor value and measure the activity value.

In the case of multi-cell kinetics, the initial value is the absorbance when the sampling is carried out first in each cell after starting measurements.

6.3.2 Setting measurement parameters

Parameters displayed on the Measurement Parameters screen can be changed by inputting the number of the item using keys. The interactive method is the same as that the main unit of spectrophotometer. Fig. 6.3.1 shows the Parameters Setting screen of the multi-cell kinetics measurement. For setting the measurement wavelength, the (GOTO WL) key is used.

After setting, pressing the (START/STOP) key changes the screen to one showing the reaction curve, and measurements will start.

When setting the sample number in advance, press the [Data List] (F2) key and set it on the data table screen.

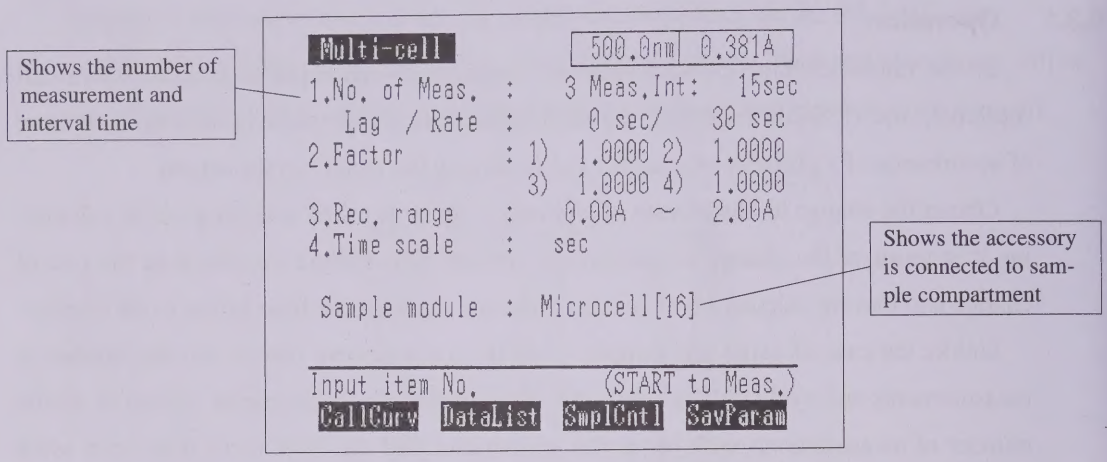

Fig. 6.3.1 Parameters setting screen (Multi-cell kinetics (1λ))

Explanation of setting items

1. No. of measurements, cycle and lag/rate

The number of measurements is used to set the number of measurements to be made with respect to one sample. The input range is from 2 to 60.

The cycle is the time from when one sampling of each sample is completed to the next sampling. If the unit is sec, the lower limit of the input range is determined based on the cell holder and the number of cells to be used. (Table 6.3.1) The upper limit of the input range is determined by the set number of measurements. The upper limit value is set so that the time value determined by cycle × (No. of measurements – 1) is less than 6553.

Lag indicates the lag time. After the measurement is started, an interval which is not used for activity value calculation is input by the time from when the measurement is started. Rate indicates the rate time and is used to input the time for activity value calculation immediately after the lag time. The input range of lag and rate is different from that of the one wavelength kinetics. Since at least two samplings (one cycle) are necessary for calculation of the rate of change, the upper limit of lag will be the value subtracted of such sampling. Therefore, the input range of lag is from 0 to {cycle × (No. of measurements – 1) – cycle}. When the lag is 0, the lower limit of rate is one cycle, and except when the lag is not 0, the lower limit of rate will be (Cycle) × 2 – (Lag). Since the upper limit is the time where the lag is subtracted from the total measurement time, it will be (Cycle) × (No. of measurements – 1) – (Lag).

2. Factor

The factor is a coefficient used to connect the rate of change of absorbance in terms of the activity value. Four kinds of factors are set respectively. The relation between them is as follows:

(Activity value) = (Factor 1)×(Factor 2)×(Factor 3)×(Factor 4)×(Rate of change)

Input range is from –9999.9 to 9999.9.

3. Recording range

The recording range is used to input the upper limit/lower limit of the Y-axis when displaying the Reaction Curve on the screen.

Input range is from –3.99 to 3.99.

4. Time unit

The unit of time can be changed by (minute) and (second). When the key is pressed, the unit of time of the item 1 is changed from min to sec and vice versa.

CallCurv

(F4) : Pressing this function key enables to call on the screen the curve data stored in the memory of the main unit or the data pack (optional). When the reaction curve is recalled, the activity value is calculated by the factor value set on the parameters setting screen with respect to the recalled waveform data, and the results will be displayed.

DataList

(F2) : When this function key is pressed, the Data Table screen will be displayed. Measurement results (sample number, initial value (ABS), Δ A/min, activity value) will be tabulated.

(See 6.6 Data list.)

SmplCntl

(F3) : When this function key is pressed, the sample compartment to be used or parameters of the sample compartment will be set. (See Chapter 15 "Sample Module Control")

SavParam

(F4) : When this function key is pressed, it is possible to save the current measurement parameters in the memory of the main unit or the data pack (optional).

Table 6.3.1 Minimum cycle (sec)

No. of cells	Multi-cell	CPS-240	8 series micro cell	16 series micro cell
2	4	4	5	4
3	5	6	8	6
4	7	8	11	8
5	9	10	14	10
6	11	12	17	12
7	—	—	20	13
8	—	—	22	15
9	—	—	—	17
10	—	—	—	19
11	—	—	—	21
12	—	—	—	23
13	—	—	—	25
14	—	—	—	27
15	—	—	—	29
16	—	—	—	30

6.3.3 Reaction curve

After the measurement is completed, measurement results will be displayed on the data table and the screen will be changed to one showing the reaction curve. (Fig. 6.3.2) The dotted line in the display screen indicates the calculation interval (the end of lag time and the end of rate time) of the activity value. × indicates the sampling point.

When a printer is connected, measurement results will be printed on the data table every time the measurement is completed. Fig. 6.3.3 shows a printed example.

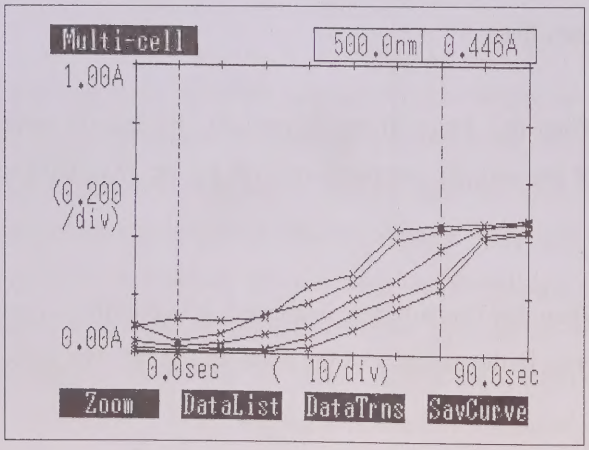

Fig. 6.3.2 Reaction curve screen (Multi-cell kinetics (1λ))

No.	Init.ABS	dA/min	Activ.
1	0.939	0.0695	0.0695
2	0.658	0.0445	0.0445
3	0.469	0.0190	0.0190
4	0.327	0.0162	0.0162
5	0.237	0.0112	0.0112
6	0.204	0.0089	0.0089
7	0.255	0.0097	0.0097
8	0.162	0.0059	0.0059

Fig. 6.3.3 Example of printed measurement results (Multi-cell kinetics (1λ))

Zoom

(F1) : Changing the range of Y-axis and X-axis of displayed reaction curve enables zooming of the reaction curve. After execution, this function returns to the [Restore] enables the status to return to one before zooming.

Data are available per sampling only. When a value of the X-axis (time axis) is input at a point other than the sampling point, the nearest sampling point including the input time is replaced with the input value of the X-axis and displayed.

DataList

(F2) : Pressing this function key changes the screen to one showing the data table. Measurement results (sample number, initial value (ABS), Δ A/min, activity value) will be displayed in tabular format. (See 6.6 Data list.)

DataOutput

(F3) : When this function key is pressed, the time and absorbance value per sampling point of reaction curve will be output on the printer (optional) or the RS-232C port. (See 6.3.4. Data Output.)

SavCurv

(F4) : When this function key is pressed, it is possible to save the reaction curve in the memory of the main unit or the data pack (optional). It is also possible to recall the reaction curve. When the reaction curve is recalled, the activity value is calculated by the factor value set in the Parameters Setting screen with respect to the recalled waveform data and the results will be displayed.

6.3.4 Data output

With this function key, it is possible to output the time and absorbance value per sampling point of reaction curve will be output on the printer (optional) or the RS-232C port.

An example of output to the printer of the format 1 is shown in Fig. 6.3.4. The same display of character-string will also be output simultaneously on the RS-232C port.

An example of output to the printer of the format 2 is shown in Fig. 6.3.5. The same display of character-string will also be output simultaneously on the RS-232C port.

The format 3 (RS-232C) will not be output to the printer. The time, cell value and absorbance will be output to the RS-232C in that order, excepting the header of the format 1.

The format 4 (RS-2332C) will not be output to the printer. The cell time, time and absorbance will be output to the RS-232C in that order, excepting the header of the format 2.

Time(sec)	Cell	ABS
0.0	1	0.939
20.0	1	0.962
40.0	1	0.985
0.0	2	0.658
20.0	2	0.673
40.0	2	0.688
0.0	3	0.469
20.0	3	0.466
40.0	3	0.475
0.0	4	0.327
20.0	4	0.332
40.0	4	0.338
0.0	5	0.237
20.0	5	0.241
40.0	5	0.245
0.0	6	0.204
20.0	6	0.207
40.0	6	0.210
0.0	7	0.255
20.0	7	0.258
40.0	7	0.261
0.0	8	0.162
20.0	8	0.164
40.0	8	0.166

Fig. 6.3.4 Example of printed Data Output format 1 (Multi-cell kinetics (1λ))

Cell	Time(sec)	ABS
1	0.0	0.939
2	0.0	0.658
3	0.0	0.469
4	0.0	0.327
5	0.0	0.237
6	0.0	0.204
7	0.0	0.255
8	0.0	0.162
1	20.0	0.962
2	20.0	0.673
3	20.0	0.466
4	20.0	0.332
5	20.0	0.241
6	20.0	0.207
7	20.0	0.258
8	20.0	0.164
1	40.0	0.985
2	40.0	0.688
3	40.0	0.475
4	40.0	0.338
5	40.0	0.245
6	40.0	0.210
7	40.0	0.261
8	40.0	0.166

Fig. 6.3.5 Example of printed Data Output format 2 (Multi-cell kinetics (1λ))

6. 4 1 cell kinetics measurement (2λ)

6.4.1 Operation

1 cell kinetics measurement (2λ) mode is used to measure the change in time of the difference in two wavelength absorbance and to obtain the change in quantity of the difference in absorbance of an interval set by the lag time and rate time by calculating it in terms of the change in quantity per minute. The method for obtaining the rate of change and that for calculation of activity value is the same as those of the one wavelength kinetics.

Unlike the case of using one wavelength, when the measurement time is set, the number of measurements and cycles will be displayed.

The number of measurements is used to set the number of measurements of the absorbance difference. The cycle is the time from when one sampling of each sample is completed to the next

sampling. In other words, it will be as follows:

(Measurement time) = (Cycle) × {(No. of measurements) – 1}

Absorbance difference is the value where the absorbance of λ2 is subtracted from the absorbance of λ1.

The display range of activity value is from -9999.9 to 9999.9. If the display range is exceeded, ##### will be displayed. When the display range is exceeded, change the factor set value and re-calculate the activity value in the data table screen. When it possible to predict in advance that the range will be exceeded, adjust the factor value and measure the activity value again.

In the case of the 1 cell kinetics (2λ), the initial value is the difference of the two wavelength absorbance which is sampled first.

6.4.2 Setting measurement parameters

Parameters displayed on the Measurement Parameters screen can be changed by entering the number of the item. Interactive method is the same as that of the main unit of spectrophotometer. Fig. 6.4.1 shows the Parameters Setting screen for the 1 cell kinetics measurement (2λ).

When setting is completed, press the (START/STOP) key and the screen will change to on showing the reaction curve and the measurements start.

When setting the sample number in advance, press the [DataList] (F2) key and set it on the data table screen.

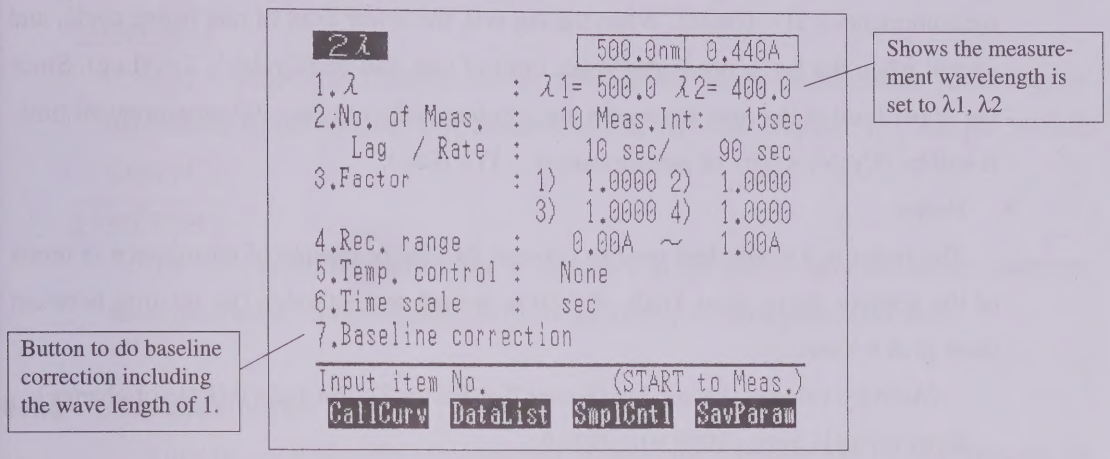

Fig. 6.4.1 Parameters setting screen (1 cell kinetics measurement (2λ))

Explanation of setting items

1. λ

   This item is used to set the measurement wavelength of λ1 and λ2.

   The input range is from 190.0 to 1100.0. Unit is nm.

2. No. of measurements, cycle, lag/rate

   The number of measurements is used to set the number of measurements with respect to one sample. The input range is from 2 to 330.

   The cycle is the time from when one sampling is completed to the next sampling. When the unit is sec, the lower limit of the input range will be restricted by the wavelength to be set. When the time consumed actually for moving wavelength has exceeded the set cycle, the cycle during measurement will be changed to the actual time. The upper limit will be determined based on the setting of the number of measurements. The upper limit value will be set so that the time value determined by Cycle × (No. of measurements – 1) will be less than 6553.

   Lag indicates the lag time. After the measurement is started, an interval which is not used for activity value calculation is input by the time from when the measurement is started. Rate indicates the rate time and is used to input the time for activity value calculation immediately after the lag time. The input range of lag and rate is different from that of the one wavelength kinetics. Since at least two samplings (one cycle) are necessary for calculation of the rate of change, the upper limit of lag will be the value subtracted of such sampling. Therefore, the input range of lag is from 0 to {Cycle × (No. of

measurements – 1) – Cycle}. When the lag is 0, the lower limit of rate is one cycle, and except when the lag is not 0, the lower limit of rate will be (Cycle) × 2 – (Lag). Since the upper limit is the time where the lag is subtracted from the total measurement time, it will be (Cycle) × (No. of measurements – 1) – (Lag).

3. Factor

The factor is a coefficient used to connect the rate of change of absorbance in terms of the activity value. Four kinds of factors are set respectively. The relation between them is as follows:

(Activity value)= (Factor 1)× (Factor 2)×(Factor 3)×(Factor 4)×(Rate of change)

Input range is from –9999.9 to 9999.9.

4. Recording range

The recording range is used to input the upper limit/lower limit of the Y-axis when displaying the Reaction Curve on the screen.

Input range is from –3.99 to 3.99.

5. Sample temperature control

This is an item provided to install electronic cold energy type temperature control sipper TSU-2200 (optional) to enable temperature setting from the main unit of spectrophotometer.

Setting items are 25°C, 30°C, 37°C and None (no temperature control), a total of four items.

6. Time unit

The unit of time can be changed by (minute) and (second). When the key is pressed, the unit of time of the item 2 is changed from min to sec and vice versa.

7. Baseline

This item is used for the baseline correction including the wavelength set by the measurement wavelength of 1.

CallCurv

(F1) : Pressing this function key enables to call on the screen the curve data stored in the memory of the main unit or the data pack (optional). When the reaction curve is recalled, the activity value is calculated by the factor value set on the parameters setting screen with respect to the recalled waveform data, and the results will be displayed.

DataList

(F2) : When this function key is pressed, the Data Table screen will be displayed. Measurement results (sample number, initial value (ABS), Δ A/min, activity value) will be tabulated.

SmplCntl

(F3) : When this function key is pressed, the sample compartment to be used or parameters of the sample compartment will be set. (See Chpater 15 "Sample Module Control".)

SavParam

(F4) : When this function key is pressed, it is possible to save the current measurement parameters in the memory of the main unit or the data pack (optional).

6.4.3 Reaction curve

After the measurement is completed, measurement results will be displayed on the data table and the screen will be changed to one showing the reaction curve. (Fig. 6.4.2) The dotted line in the display screen indicates the calculation interval (the end of lag time and the end of rate time) of the activity value. x indicates the sampling point.

When a printer is connected, measurement results will be printed on the data table every time the measurement is completed. Fig. 6.4.3 shows a printed example.

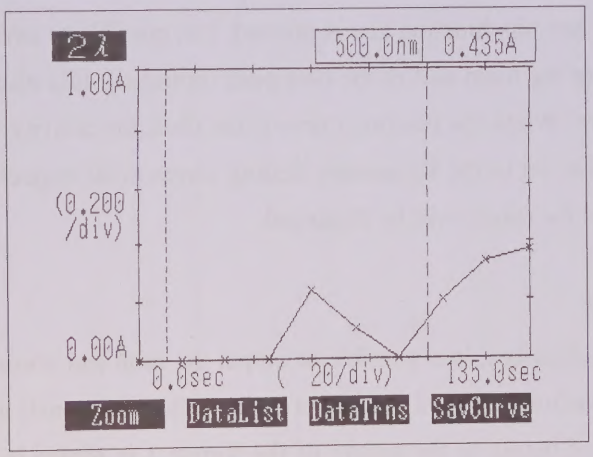

Fig. 6.4.2 Reaction curve screen (1 cell kinetics (2λ))

No.	Init.ABS	dA/min	Activ.
1	-0.001	-0.0654	-0.0654
2	-0.237	4.0289	4.0289
3	0.461	0.1893	0.1893

Fig. 6.4.3 Example of printed measurement results (1 cell kinetics (2λ))

Zoom

(F1) : Changing the range of Y-axis and X-axis of displayed reaction curve enables zooming of the reaction curve. After execution, this function returns to the Restore enables the status to return to one before zooming.

Data are available per sampling only. When a value of the X-axis (time axis) is input at a point other than the sampling point, the nearest sampling point including the input time is replaced with the input value of the X-axis and displayed.

DataList

(F2) : Pressing this function key changes the screen to one showing the data table. Measurement results (sample number, initial value (ABS), Δ A/min, activity value) will be displayed in tabular format. (See 6.6 Data list.)

DataOutput

(F3) : When this function key is pressed, the time and absorbance value per sampling point of reaction curve will be output on the printer (optional) or the RS-232C port. (See 6.4.4. Data Output.)

SavCurv

(F4) : When this function key is pressed, it is possible to save the reaction curve in the memory of the main unit or the data pack (optional). It is also possible to recall the reaction curve. When the reaction curve is recalled, the activity value is calculated by the factor value set in the Parameters Setting screen with respect to the recalled waveform data and the results will be displayed.

6.4.4 Data output

With this function key, it is possible to output the time and absorbance value per sampling point of reaction curve will be output on the printer (optional) or the RS-232C port.

An example of output to the printer of the format 1 is shown in Fig. 6.4.4. The same display of character-string will also be output simultaneously on the RS-232C port.

The format 2 (RS-232C) will not be outputted to the printer. Time and absorbance will be output in pairs to the RS-232C port excepting the header and data number of the format 1.

No.	Time(sec)	ABS
1	0.0	0.461
2	2.0	0.372
3	4.0	0.742
4	6.0	0.734
5	8.0	0.614
6	10.0	0.764
7	12.0	0.648
8	14.0	0.731
9	16.0	0.770
10	18.0	0.438
11	20.0	-0.028

Fig. 6.4.4 Example of printed output format 1 (1 cell kinetics (2λ))

6.5 Rate measurement

6.5.1 Operation

The rate measurement mode is used to measure the change in time of absorbance for one wavelength just as the 1 cell kinetics measurement (1λ). In this mode, no display is shown on the reaction curve screen. The change in quantity of absorbance per set cycle is calculated in terms of the change in quantity per minute. The cycle time here is equivalent to the rate time.

Linear regression of the sampling data during one cycle is carried out by the method of least squares to obtain the rate of change (Δ Abs/min). Activity values are obtained by multiplying the rate of change by four factor values.

(Activity value) = (Factor 1)×(Factor 2)×(Factor 3)×(Factor 4)×(Rate of change)

Activity values are displayed in the range from –9999.9 to 9999.9.

If this range is exceeded, ##### will be displayed. If the range is exceeded, change the set values of the factor and re-calculate them on the data table screen. If it is possible to predict the exceeded range, adjust the factor values and take the measurement again.

The initial value is the first absorbance of each cycle.

A discriminant is used to determine whether the reaction is being progressed linearly and to display the linearity (L) or the non-linearity (N). The discriminant is as follows. It determines whether the ratio of the rate of change of absorbance due to the reaction during one cycle and the rate of change of one cycle before is within the proportion (%) set in the criteria.

(Discriminant)

|{(rate of change of one cycle before)-(rate of change of cycle)}/ (rate of change of one cycle before)|×100<(criteria)

6.5.2 Setting measurement parameters

Parameters displayed on the Measurement Parameters screen can be changed by entering the number of the item using keys. Interactive method is the same as that of the main unit of spectrophotometer.

Fig. 6.5.1 shows the Parameters Setting screen for the rate measurement.

For setting the measurement wavelength, the (GOTO WL) key is used.

When setting is completed, press the (START/STOP) key and the screen will change to the measurement screen and the measurements start. When setting the sample number in advance, press the [DataList] (F2) key and set it on the data table screen.

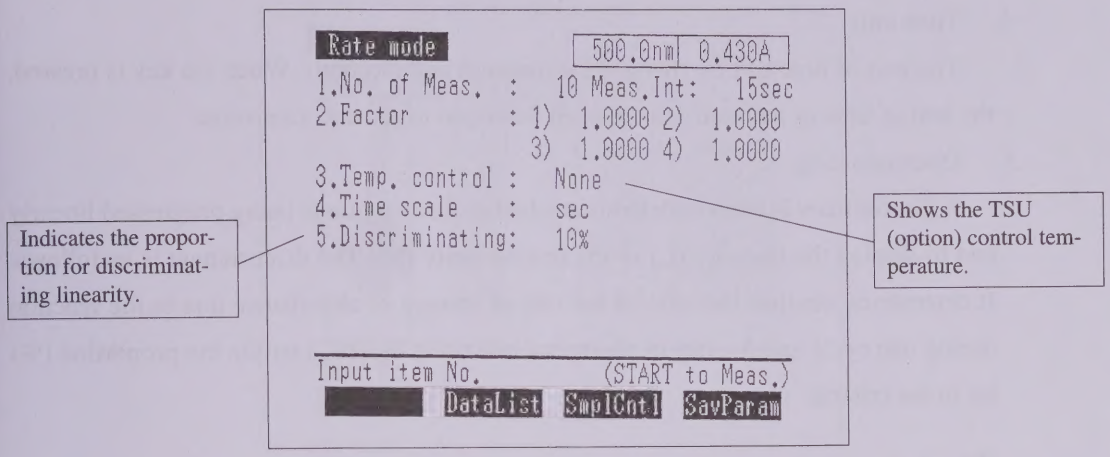

Fig. 6.5.1 Parameters setting screen (Rate measurement)

Explanation of setting items

1. No. of measurements, cycle

   Number of measurements is used to set the number of rates to be measured with respect to one sample. The input range is from 2 to 117.

   The cycle is the time of one rate measurement of each sample.

   If the unit is sec, the input range is from 3 to 6553, and if the unit is min, the input range is from 1 to 6553.

2. Factor

   The factor is a coefficient used to connect the rate of change of absorbance in terms of the activity value. Four kinds of factors are set respectively. The relation between them is as follows:

   (Activity value)= (Factor 1)×(Factor 2)×(Factor 3)×(Factor 4)×(Rate of change)

   Input range is from –9999.9 to 9999.9.

3. Sample temperature control

   This is an item provided to install electronic cold energy type temperature control sipper TSU-2200 (optional) to enable temperature setting from the main unit of spectrophotometer.

   Setting items are 25°C, 30°C, 37°C and None (no temperature control), a total of four items.

4. Time unit

The unit of time can be changed by (minute) and (second). When the key is pressed, the unit of time of the item 1 is changed from min to sec and vice versa.

5. Discriminating

A discriminant is used to determine whether the reaction is being progressed linearly and to display the linearity (L) or the non-linearity (N). The discriminant is as follows. It determines whether the ratio of the rate of change of absorbance due to the reaction during one cycle and the rate of change of one cycle before is within the proportion (%) set in the criteria.

(Discriminant)

|{(rate of change of one cycle before)-(rate of change of cycle)}/ (rate of change of one cycle before)|×100<(criteria)

DataList

(F2) : Pressing this function key changes the screen to one showing the data table. Measurement results (Time, initial value (ABS), Δ A/min, activity value, judgment results (D)) will be displayed in tabular format.

SmplCntl

(F3) : When this function key is pressed, the sample compartment to be used or parameters of the sample compartment will be set. (See Chpater 15 "Sample Module Control".)

SavParam

(F4) : When this function key is pressed, it is possible to save the current measurement parameters in the memory of the main unit or the data pack (optional).

6.5.3 Measurement screen (Data List)

During measurements, the screen will display measurement results per successive cycle on the data list. Fig. 6.5.2 shows the screen of the data list after the measurement is completed.

When a printer (optional) is connected, measurement results displayed on the data list per measurement cycle will be printed.

Fig. 6.5.3 shows an example of printed measurement results.

Rate mode 500.0nm 0.432A

Time s	ABS(init.)	△A/min	Activ.	D
15	0.438	-0.0314	-0.0314	N
30	0.431	-0.0498	-0.0498	N
45	0.420	0.0158	0.0158	N
60	0.426	-0.7420	-0.7420	N
75	0.261	0.0345	0.0345	N
90	0.272	-0.0495	-0.0495	N
105	0.262	0.0437	0.0437	N

Smpl No.=1

Smpl No.=2 DataDisp

Fig. 6.5.2 Reaction curve screen (Rate measurement)

Sample No. = 1

Time(sec)	Init.ABS	dA/min	Activ.	D
5	1.142	-0.3413	-3.4131	N
10	1.113	-0.2900	-2.9004	N
15	1.089	-0.2476	-2.4756	N
20	1.068	-0.2402	-2.4023	L
25	1.048	-0.2241	-2.2412	L
30	1.030	-0.2168	-2.1680	L
35	1.012	-0.1743	-1.7432	N
40	0.997	-0.1553	-1.5527	N
45	0.984	-0.1509	-1.5088	L
50	0.972	-0.1597	-1.5967	L
55	0.958	-0.1377	-1.3770	N
60	0.947	-0.1260	-1.2598	L
65	0.936	-0.1187	-1.1865	L
70	0.926	-0.1099	-1.0986	L
75	0.917	-0.1025	-1.0254	L
80	0.909	-0.0981	-0.9814	L
85	0.901	-0.0879	-0.8789	N
90	0.893	-0.1025	-1.0254	N
95	0.885	-0.0850	-0.8496	N
100	0.878	-0.0894	-0.8936	L

Fig. 6.5.3 Example of printed measurement results (Rate measuerment)

Smpl No.

(F1) : With this function key, it is possible to change the number of the sample to be measured next.

The input range of the sample number is from 0 to 9999.

DataDisp

(F4) : Pressing this function key changes the screen to that of tabulated data. All of the measurement results can be displayed or printed. It is also possible to save and delete the tabulated data. (See 6.5.4. List display of rate measurement.)

6.5.4 List display of rate measurement

Fig. 6.5.4 shows the screen of list display, on which results of rate measurement can be listed for review. It is also possible to output a batch of all measurement results on a printer or store them in the memory of the main unit or the data pack (optional).

Rate mode

Time s	ABS(init.)	ΔA/min	Activ.	D
15	0.438	-0.0314	-0.0314	N
30	0.431	-0.0498	-0.0498	N
45	0.420	0.0158	0.0158	N
60	0.426	-0.7420	-0.7420	N
75	0.261	0.0345	0.0345	N
90	0.272	-0.0495	-0.0495	N
105	0.262	0.0437	0.0437	N

Smpl No.=1

DataFile PrintOut ▲ ▼

Fig. 6.5.4 Screen of list display (rate measurement)

DataFile

(F1) : This function key enables storing measurement results into the memory of the main unit or the data pack (optional).

PrintOut

(F2) : Pressing this function key outputs a batch of all measurement results (time), initial value (ABS), Δ A/min, activity value and judgment results (D) on a printer (optional) or on the RS-232C port. Three kinds of formats are available.

△ , ▽

(F3) , (F4) : This function key enables scrolling of measurement results by 8 data.

Output format of PrintOut will be as follows.:

An example of the format 1 output on the printer is shown in Fig. 6.5.5. The same character-string of the same data will be output simultaneously on the RS-232C port.

Fig. 6.5.6 shows an example of the format 2 output on the printer. The same character-string of the same data will be output on the RS-232C port.

The format 3 will not be output on the printer. Except the header to the format 1, time, initial value (ABS), Δ A/min, activity value and judgment results (D) are output on the RS-232C port in that order.

```
Sample No. = 1
 Time(sec) Init.ABS  dA/min  Activ. D
-----------------------------------------
      5      1.142 -0.3413 -3.4131 N
     10      1.113 -0.2900 -2.9004 N
     15      1.089 -0.2476 -2.4756 N
     20      1.068 -0.2402 -2.4023 L
     25      1.048 -0.2241 -2.2412 L
     30      1.030 -0.2168 -2.1680 L
     35      1.012 -0.1743 -1.7432 N
     40      0.997 -0.1553 -1.5527 N
     45      0.984 -0.1509 -1.5088 L
     50      0.972 -0.1597 -1.5967 L
     55      0.958 -0.1377 -1.3770 N
     60      0.947 -0.1260 -1.2598 L
     65      0.936 -0.1187 -1.1865 L
     70      0.926 -0.1099 -1.0986 L
     75      0.917 -0.1025 -1.0254 L
     80      0.909 -0.0981 -0.9814 L
     85      0.901 -0.0879 -0.8789 N
     90      0.893 -0.1025 -1.0254 N
     95      0.885 -0.0850 -0.8496 N
    100      0.878 -0.0894 -0.8936 L
```

Fig. 6.5.5 Example of output format 1 (rate measurement)

```
Sample No. = 1
Init.ABS  dA/min  Activ.
-------------------------
 Time(sec)     5    D:N
   1.142 -0.3413 -3.4131
 Time(sec)    10    D:N
   1.113 -0.2900 -2.9004
 Time(sec)    15    D:N
   1.089 -0.2476 -2.4756
 Time(sec)    20    D:L
   1.068 -0.2402 -2.4023
 Time(sec)    25    D:L
   1.048 -0.2241 -2.2412
 Time(sec)    30    D:L
   1.030 -0.2168 -2.1680
```

Fig. 6.5.6 Example of output format 2 (rate measurement)

6.6 Data list

As shown in Fig. 6.6.1, measurement results (Smpl No., ABS (init.), Δ A/min, Activ) will be displayed in the tabular format. Measurement results will be added below every time a measurement or re-calculation is made. The maximum number of data of measurement results is 105. To save or delete these measurement results, press the DataDisp (F4) function key to bring up the screen of data display for further processing.

Lag time and rate time displayed on the lower row see the newest results.

1λ 500.0nm 0.459A

Smpl No.	ABS(init.)	ΔA/min	Activ.
1	0.414	0.1271	0.1271
2	0.410	-0.0420	-0.0420
3	0.412	-0.0120	-0.0120
4	0.416	-0.0512	-0.0512
5	0.405	-0.0485	-0.0485
6	0.326	0.3070	0.3070
7	0.209	7.2703	7.2703
8			

Lag time = 2sec Rate time= 1sec

Smpl No. Curve Re-Calc. DataDisp

Fig. 6.6.1 Data table screen (1 cell kinetics measurement (1λ))

Smpl No.

(F1) : With this function key, it is possible to change the number of the sample to be measured next.

The input range of the sample number is from 0 to 9999.

Curve

(F2) : Pressing this function key changes the screen to that of the reaction curve.

Re-Calc.

(F3) : With this function, it is possible to change the lag time and rate time to re-calculate the activity value. Results of re-calculation will be displayed with the original sample number provided with numbers with dash. One sample can be re-calculated for up to 9 times.

DataDisp

(F4) : Pressing this function key changes the screen to that of tabulated data. All of the measurement results can be displayed or printed. It is also possible to save and delete the tabulated data. (See 6.7 List display.)

6.7 List display

Fig. 6.7.1 shows the screen of list display. In the screen of the data list, results of only 7 measurements taken immediately before will be displayed. In this case, it is possible to display all of the measurement results. It is also possible to output a batch of all measurement results on a printer or store them in the memory of the main unit or the data pack (optional). Part of measurement results or all of the measurement results may be deleted or erased. Rate of change may be input in manual mode.

1 λ

Smpl No.	ABS(init.)	ΔA/min	Activ.
1	0.414	0.1271	0.1271
2	0.410	-0.0420	-0.0420
3	0.412	-0.0120	-0.0120
4	0.416	-0.0512	-0.0512
5	0.405	-0.0485	-0.0485
6	0.326	0.3070	0.3070
7	0.209	7.2703	7.2703

1. Change Rate 2. delete 3. Clear

DataFile PrintOut ▲ ▼

Fig. 6.7.1 Screen of list display (1 cell kinetics measurement (1λ))

1. Change Rate

   In this mode, it is possible to input the value of the rate of change (Δ A/min) and change it using keys. When the rate of change is changed, the activity value will be re-calculated by the factor used for measurements.

   The input range is from –9999.9 to 9999.9.

2. Delete

   With this mode, it is possible to delete any of the measurement results. Select data to be deleted with the cursor key and press the (ENTER) key. Defective data can be deleted.

3. Clear

   A batch of all measurement results will be erased.

DataFile

(F1) : This function key enables storing measurement results into the memory of the main unit or the data pack (optional).

PrintOut

(F2) : Pressing this function key outputs a batch of all measurement results (sample No., initial value (ABS), Δ A/min, and activity value) on a printer (optional) or on the RS-232C port. Three kinds of formats are available.

△ , ▽

(F3) , (F4) : This function key enables scrolling of measurement results by 8 data.

Output format of PrintOut will be as follows.:

An example of the format 1 output on the printer is shown in Fig. 6.7.2. The same character-string of the same data will be output simultaneously on the RS-232C port.

Fig. 6.7.3 shows an example of the format 2 output on the printer. The same character-string of the same data will be output on the RS-232C port.

The format 3 will not be output on the printer. Except the header to the format 1, sample No., initial value (ABS), Δ A/min, and activity value are output on the RS-232C port in that order.

No.	Init.ABS	dA/min	Activ.
1	0.138	0.0690	0.0690
2	0.143	0.0490	0.0490
3	0.189	0.0325	0.0325
4	0.096	0.0289	0.0289
5	0.114	0.0201	0.0201
6	0.082	0.0148	0.0148
7	0.119	0.0122	0.0122
8	0.120	0.0097	0.0097
9	0.632	0.0629	0.0629
10	0.469	0.0462	0.0462
11	0.379	0.0380	0.0380
12	0.307	0.0260	0.0260
13	0.244	0.0163	0.0163
14	0.187	0.0131	0.0131
15	0.185	0.0100	0.0100
16	0.190	0.0072	0.0072
17	1.060	0.0613	0.0613
18	0.783	0.0401	0.0401
19	0.634	0.0350	0.0350
20	0.483	0.0223	0.0223
21	0.356	0.0153	0.0153
22	0.275	0.0117	0.0117
23	0.233	0.0087	0.0087
24	0.239	0.0073	0.0073
33	1.614	0.0588	0.0588
34	1.144	0.0371	0.0371
35	0.949	0.0334	0.0334
36	0.690	0.0224	0.0224
37	0.473	0.0123	0.0123
38	0.383	0.0105	0.0105
39	0.313	0.0078	0.0078
40	0.304	0.0069	0.0069

Fig. 6.7.2 Example of output format 1 (1 cell kinetics (1λ))

	Init.ABS	dA/min	Activ.
No. 1	0.138	0.0690	0.0690
No. 2	0.143	0.0490	0.0490
No 3	0.189	0.0325	0.0325
No. 4	0.096	0.0289	0.0289
No. 5	0.114	0.0201	0.0201
No. 6	0.082	0.0148	0.0148
No. 7	0.119	0.0122	0.0122
No. 8	0.120	0.0097	0.0097
No. 9	0.632	0.0629	0.0629
No. 10	0.469	0.0462	0.0462
No. 11	0.379	0.0380	0.0380
No. 12	0.307	0.0260	0.0260
No. 13	0.244	0.0163	0.0163
No. 14	0.187	0.0131	0.0131
No. 15	0.185	0.0100	0.0100
No. 16	0.190	0.0072	0.0072
No. 17	1.060	0.0613	0.0613
No. 18	0.783	0.0401	0.0401
No. 19	0.634	0.0350	0.0350
No. 20	0.483	0.0223	0.0223
No. 21	0.356	0.0153	0.0153
No. 22	0.275	0.0117	0.0117
No. 23	0.233	0.0087	0.0087
No. 24	0.239	0.0073	0.0073
No. 33	1.614	0.0588	0.0588
No. 34	1.144	0.0371	0.0371
No. 35	0.949	0.0334	0.0334
No. 36	0.690	0.0224	0.0224
No. 37	0.473	0.0123	0.0123
No. 38	0.383	0.0105	0.0105
No. 39	0.313	0.0078	0.0078
No. 40	0.304	0.0069	0.0069

Fig. 6.7.3 Example of output format 2 (1 cell kinetics (1λ))

6.8 Reaction curve (waveform data) and measurement results (list data)

With this measurement mode, it is possible to store the two kinds of data of the reaction curve (waveform data) and measurement results (list data) into the memory of the main unit or the data pack (optional) or recall them.

The reaction curve can be processed with the SavCurve and CallCurv and the measurement results can be processed with the DataFile, but No.0.Original will always be the waveform data during measurement when the list of file is displayed.

It is possible to store 6 files into the memory of the main unit and 27 files into the data pack, including the original. However, the waveform data and list data will be mixed and present when the list of file is displayed. Even with Header function, "special format" will displayed for all measurements except the reaction curve of 1 cell kinetics measurement (1λ). Therefore, when the measurement data of various measurement modes are mixed and present, it is necessary to devise how to designate the file name because it will be difficult to discriminate files.

Chapter 7. Time scan mode

The time scan mode is used to measure the change in time of absorbance (ABS), transmittance (%T), or energy (E) in the specified arbitrary wavelength.

Following two measurement methods are provided:

- 1 cell measurement
- Multi-cell measurement (optional sample compartment is required.)

With multi-cell measurement, maximum 16 samples can be measured by connecting the multi-cell, or CPS-240.

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7.3.1 Setting measurement parameters....7-7

7.3.2 Reaction curve....7-8

7. 1 Selecting the measurement method

When <5. Time scan> is selected on the mode selection screen, the following measurement method selection screen (Fig. 7.1) is displayed.

```
Time scan

1. 1cell Time scan
2. Multi-cell Time scan

Input item No.
```

Fig. 7.1 Measurement method selection screen

The time scan mode is provided with two types of measurement method. Overview of each measurement method is as follows.

(1) 1 cell measurement

This method is used to measure the change in time of absorbance or transmittance of arbitrary one cell in the sample chamber.

(2) Multi-cell measurement

This method is used to measure the change in time of max. 16 samples, using accessories such as multi-cell, micro multi-cell, and CPS-240.

7.2 1 cell measurement

7.2.1 Setting the measuremunt parameters

When <1. 1 cell Time scan> is selected from the measurement method selection screen to display the measurement parameters setting screen (Fig. 7.2).

Set the respective items of measurement parameters by key dialog method. Condition to be set is selected by inputting the item number.

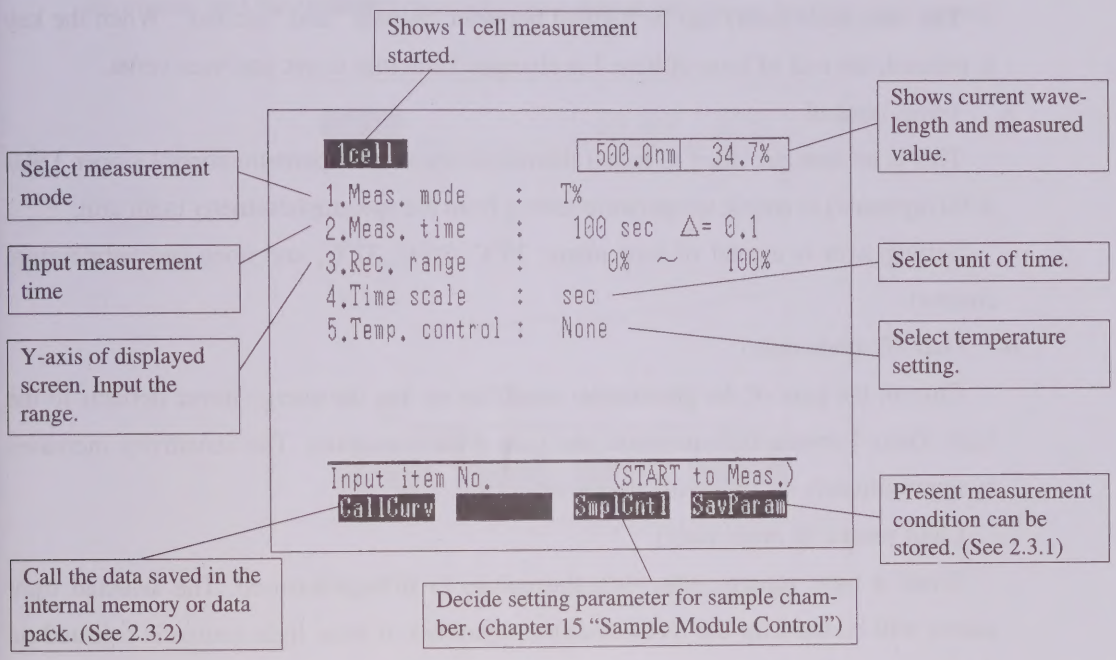

Fig. 7.2 1 cell measurement parameters setting screen

1. Meas. mode

   Select absorbance (ABS), transmittance (%T), or energy (E).

2. Meas. Time

   Input the measurement time. Sampling interval is automatically set in accordance with the measurement time (see Table 7.1).

Table 7.1 Measurement time and sampling interval

Measurement time	Sampling interval
1 ~ 100	0.1
101 ~ 200	0.2
201 ~ 500	0.5
501 ~ 1000	1.0
1001 ~ 2000	2.0
2001 ~ 5000	5.0
5001 ~ 6500	10.0

3. Rec. range

The recording range is used to input the upper limit/lower limit of Y-axis when displaying the reaction curve on the screen.

Input range is from -3.99 to 3.99.

4. Time scale

The time scale (unit) can be toggled between "minute" and "second". When the key is pressed, the unit of time of item 1 is changed from min to sec and vice versa.

5. Temp. control

This is an item provided to install thermoelectrically temperature control sipper TSU-2200 (optional) to enable temperature setting from the spectrophotometer main unit.

Setting item is a total of four items: 25°C, 30°C, 37°C, and none (no temperature control)

6. Gain (E mode only)

Control the gain of the photometer amplifier so that the energy never deflects to the limit. Gain 1 means the minimum and gain 4 the maximum. The sensitivity increases by approximately 4 times with each level.

7. Light source (E mode only)

Select a light source only when the energy is to be measured. The selected light source will be used for the measurement, regardless of what light source is selected on the Parameter Configuration screen.

W lamp : Selects the tungsten iodine lamp (halogen lamp) as the light source.

D_2 lamp : Selects the deuterium lamp as the light source.

OFF : Turns OFF both of the W and D_2 lamps. The light source mirror turns to the third light source.

Call Curv

Pressing this function key enables to call on the screen the curve data recorded in the memory of the main unit or the data pack (optional). (See 2.3.2 Save Curve and Call Curve.)

Smpl Cntl

This function key is used to set the parameters of sample chamber to be used or number of cells. (See Chapter 15 "Sample Module Control".)

Sav Param

When this function key is pressed, the current measurement parameters can be saved in the memory of the main unit or the data pack (optional). (See 2.3.1 Save Parameters.)

7.2.2 Reaction curve

When (START/STOP) key is pressed on the parameter setting screen, the screen to display the reaction curve appears, on which the change in time of absorbance (transmittance or energy) of the sample is displayed in real-time. (Fig. 7.3)

When the measurement is completed, press the cursor key (◁ or ▷) to display the cursor, and the time and the measured value at the cursor position can be read.

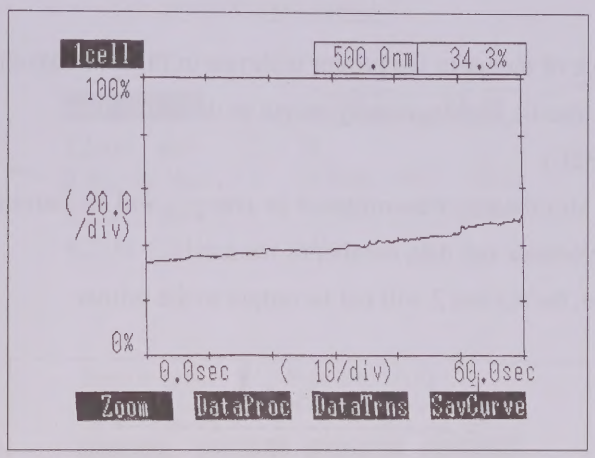

Fig. 7.3 1 cell measurement screen

Zoom (F1) key

When this key is pressed, range of Y-axis and X-axis of displayed reaction curve can be changed. After execution, this function returns to the Restore and enables the status return to one before zooming.

Data are available only in sampling interval. When a value of the X-axis (time axis) is input at a point other than the sampling point, the nearest sampling point including the input time is replaced with the input value of the X-axis and then displayed.

Data Proc (F2) key

It is possible to perform data processing such as differential, four basic operations of arithmetic, and area calculation is possible for the measured data.

(See Chapter 11 "Data Processing".)

Data Trns (F3) key

When this function key is pressed, the time and absorbance value (transmittance value or energy value) per sampling point of reaction curve will be output to the printer of RS-232C port.

Following two output formats are provided. Select with the cursor key (◁ or ▷) and press (ENTER).

Format 1

An example of output to the printer is shown in Fig. 7.4 The character-string of same contents will also be simultaneously output to the RS-232C.

Format 2 (RS-232C)

Time and absorbance (transmittance or energy) will be output to the RS-232C port excluding the header and data number of format 1.

In this case, the format 2 will not be output to the printer.

No.	Time(sec)	T%
1	0.0	33.5
2	0.1	33.5
3	0.2	33.5
4	0.3	33.5
5	0.4	33.7
6	0.5	33.6
7	0.6	33.8
8	0.7	33.8
9	0.8	34.0
10	0.9	34.0
11	1.0	34.0

Fig. 7.4 Example of printed data output format 1 (1 cell measurement)

Sav Curve (F1) key

When this function key is pressed, it is possible to save the reaction curve in the memory of the main unit or the data pack (optional).

(See 2.3.2 Save Curve and Call Curve.)

7.3 Multi-cell measurement

7.3.1 Setting measurement parameters

When <2. Multi-cell Time scan> is selected from the measurement method selection screen, the measurement parameter setting screen is displayed. (Fig. 7.5)

Set the items of measurement parameters by key dialog method. Select parameters to be set by inputting the item number.

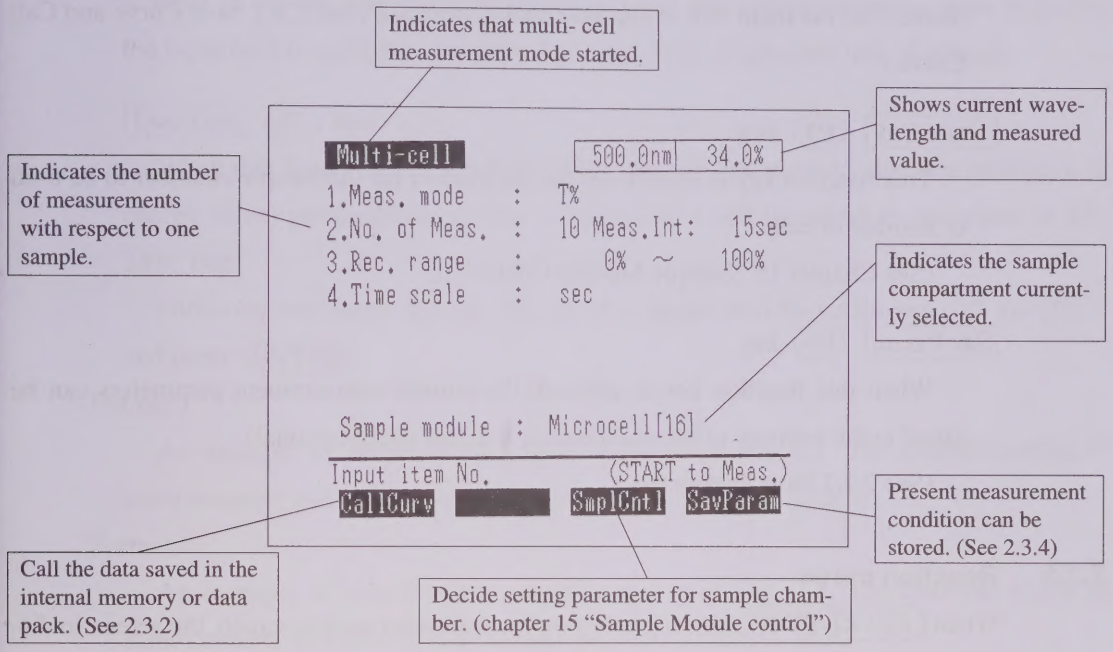

Fig. 7.5 Multi-cell measurement parameter setting screen

1. Meas. mode

   Select absorbance (ABS), transmittance (%), or energy (E).

2. No. of Meas.

   This parameter is used to set the number of measurements to be made with respect to one sample. The input range is 2 to 60. The cycle is the time from when one sampling of each sample is completed to next sampling. The input range is determined depending on the sample chamber and number of cells to be used when the time scale is "sec". (See Table 6.3.1 "Minimum cycle (sec)")

3. Rec. range

   The recording range is used to input the upper limit/lower limit of Y-axis when displaying the Reaction Curve on the screen.

4. Time scale

The time scale (unit) can be toggled by "minute" and "second". When the key is pressed, the unit of time of item 2 is changed from min to sec and vice versa.

Call Curve (F1) key

Pressing this function key enables to call on the screen the curve data saved in the memory of the main unit or the data pack (optional). (See 2.3.2 Save Curve and Call Curve.)

Smpl Ctrl (F3) key

This function key is used to set the parameters for the sample chamber to be used or number of cells.

(See Chapter 15 "Sample Module Control".)

Sav Param (F4) key

When this function key is pressed, the current measurement parameters can be saved in the memory of the main unit or the data pack (optional).

(See 2.3.1 Save Parameters.)

7.3.2 Reaction curve

When (START/STOP) key is pressed on the parameter setting screen, the screen to display the reaction curve appears, on which the change in time of absorbance (transmittance or energy) of the sample is displayed in real-time. (Fig. 7.6)

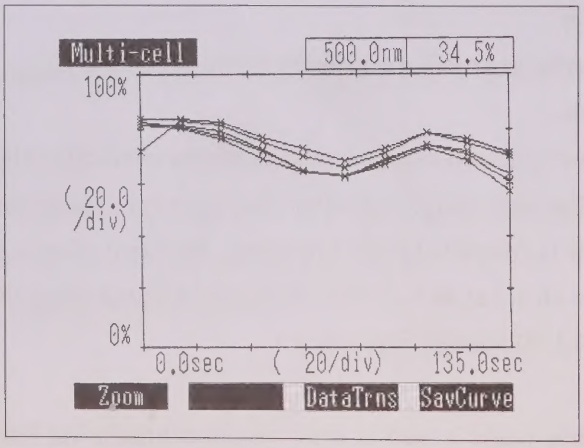

Fig. 7.6 Multi-cell measurement screen

Zoom (F1) key

Range of Y-axis and X-axis of displayed reaction curve can be changed. After execution, this function returns to the Restore and enables the status return to one before zooming.

Data are available only in sampling interval. When a value of the X-axis (time axis) is input at a point other than the sampling point, the nearest sampling point including the input time is replaced with the input value of the X-axis and then displayed.

DataTrns (F3) key

When this function key is pressed, the time and absorbance value (transmittance or energy value) per sampling point of reaction curve will be output to the printer or RS-232C port.

Following two output formats are provided. Select with the cursor key (◁ or ▷) and press (ENTER).

Format 1

An example of output to the printer is shown in Fig. 7.7. The character-string of same contents will also be simultaneously output to the RS-232C.

Format 2

An example of output to the printer is shown in Fig. 7.8. The character-string of same contents will also be simultaneously output to the RS-232C.

Format 3 (RS-232C)

Format 3 is output to RS-232C port in the order of time, cell value, and absorbance (transmittance or energy) will be output to the RS-232C port excluding the header of format 1.

The format 3 will not be output to the printer.

Format 4 (RS-232C)

Format 4 is output to RS-232C port in the order of cell value, time, and absorbance (transmittance or energy) will be output to the RS-232C port excluding the header of format 2.

The format 4 will not be output to the printer.

Time(sec)	Cell	T%
0.0	1	83.5
15.0	1	84.0
30.0	1	82.8
45.0	1	77.8
60.0	1	73.1
75.0	1	68.6
90.0	1	73.8
105.0	1	78.7
120.0	1	76.5
135.0	1	71.4
0.0	2	71.9
15.0	2	83.5
30.0	2	81.7
45.0	2	75.1
60.0	2	70.4
75.0	2	66.1
90.0	2	71.4

Fig. 7.7 Example of format 1 printout (Multi-cell measurement)

Cell	Time(sec)	T%
1	0.0	83.5
2	0.0	71.9
3	0.0	81.7
4	0.0	82.7
5	0.0	81.6
1	15.0	84.0
2	15.0	83.5
3	15.0	81.4
4	15.0	81.1
5	15.0	80.3
1	30.0	82.8
2	30.0	81.7
3	30.0	79.2
4	30.0	77.5
5	30.0	76.1

Fig. 7.8 Example of format 2 printout (Multi-cell measurement)

SavCurve (F4) key

When this function key is pressed, the current measurement parameters can be saved in the memory of the main unit or the data pack (optional).

(See 2.3.2 Save Curve and Call Curve.)

Chapter 8. Multi-component Quantitation Mode

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8. 1 Multi-component Quantitation

The multi-component quantitation mode is the mode in which the concentration of each constituent component is determined by using the absorption spectrum of the mixed sample with pure standards or standards made up of multiple constituent components.

1) Mixed samples with up to 8 constituent components can be quantitated.
2) In addition to using pure samples of each constituent component as the standard samples, a mixed sample in which the concentration of each constituent component is known may also be used.

   The effects of interference among the various constituent components can be minimized by using a mixed sample as the standard sample.
3) The standard sample data can be saved with the measurement parameters in memory. In addition, a spectrum saved in memory can be used as the standard sample or unknown sample data. However,unlike other parameter files, these can only be saved one at a time.
4) The measurement wavelengths can be set at uniform intervals or randomly set. You can freely select the measurement wavelengths to improve measurement accuracy.

Note

1) If Multi-component quantitation calculation cannot be performed due to, e.g., an unsuitable standard sample, the error message "Multi-component calculation error" will be displayed on the screen.

```
Multi-Component
No solution

 Multi-Component calculation error
Try to measure Standard data again.
 The cause of No solution status.
  1)The ABS data at a selected λ are
    almost zero.
  2)Two or more Standard spectra
    are practically identical.

Press STOP key
```

2) If a sample whose absorbance is virtually zero, or a sample with a closely similar absorption spectrum shape is used as the standard sample, isolation quantitation calculations may not be able to be performed or accurate values may not be found.
3) If a mixed sample with 4 or more constituent components is used as the standard sample, it is highly probable that isolation quantitation calculations will not be able to be performed.

8. 2 Load Stored Measurement Parameters

When you select <5. Multi-Component> in the mode selection screen, a screen will be displayed for loading measurement parameters and standard sample data which have been saved.

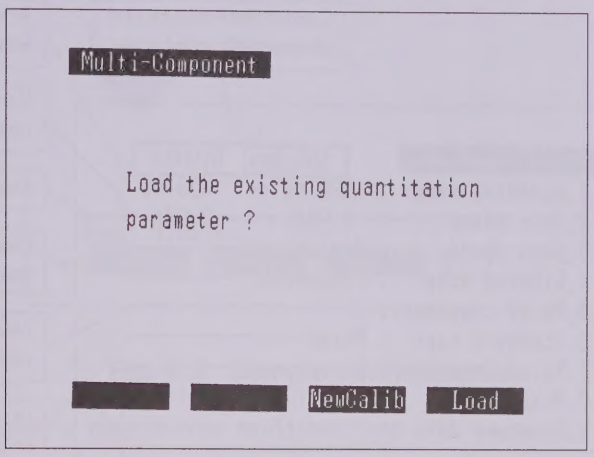

Fig. 8.1 Load saved parameters screen

Only one set of the measurement parameters from the multi-component quantitation mode can be saved together with the standard sample data in a separate memory location from other measurement modes.

When you select [Load], the measurement parameters which have been saved in memory are loaded.

You may also select [NewCalib] to reset new parameters.

Now, if there are no parameters saved, this screen will not be displayed.

Note Standard sample data which are saved are only those data which are required for quantitation calculations. Spectra cannot be saved.
To save a standard sample spectrum, it must have already been measured in the spectrum mode and the results saved to memory.
Spectrum which have been saved using the [CallCurv] function can be used as standard sample data. (See 8.4.2 Measure Standard Sample)

8.3 Measurement Parameter Configuration Screen

When you load parameters or select new settings, the parameter configuration screen will be displayed.

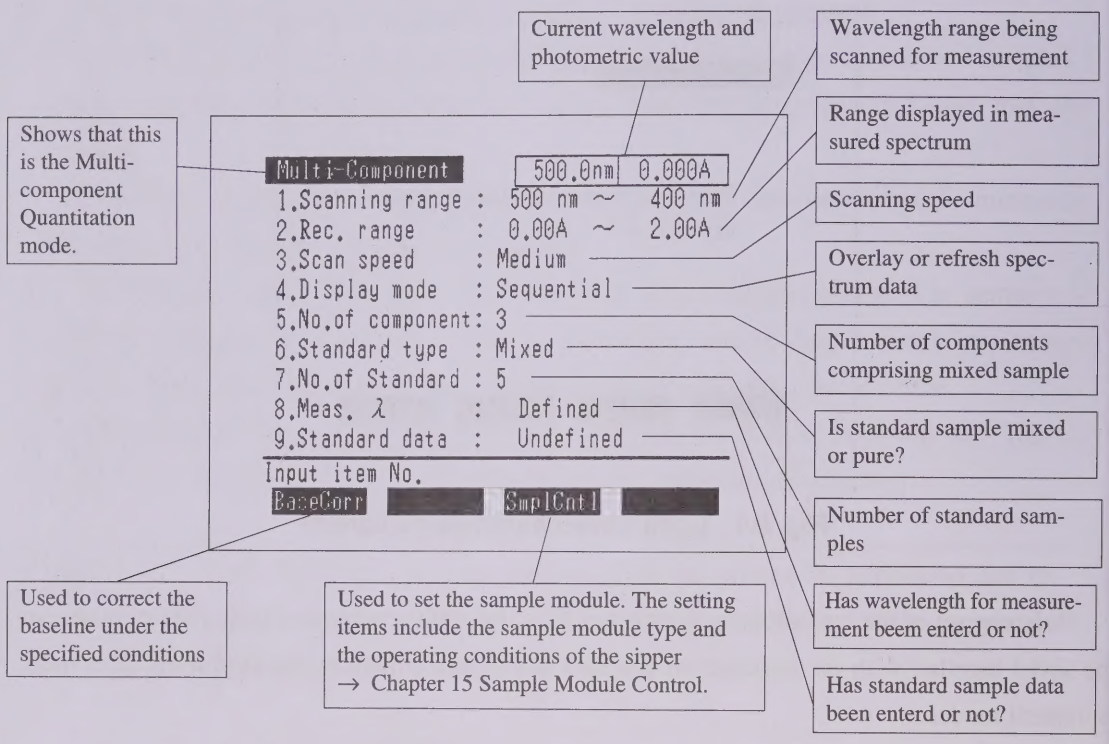

Fig. 8.2 Parameter Configuration screen

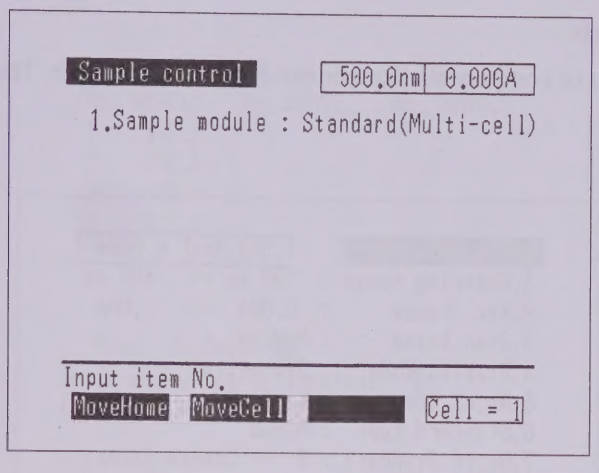

Fig. 8.3 Sample control screen

In the Multi-component quantitation mode, multiple cells cannot be measured automatically using a multi-cell, micro multi-cell, or CPS-240 (all options).

The multi-component quantitation mode has more parameters to be set than other measurement modes. Set the various items according to the instructions on the screen.

Parameters <1.> through <4.> are virtually identical with those in the Spectrum mode (See Chapter 4).

Some parameter items are interrelated. e.g. <5. No. of component> and <7. No. of Standard>

Note When you change parameter items <1.> and <5.> through <9.>, the standard sample data will be deleted. If you have selected one of these items by mistake, you can cancel by pressing (RETURN).
If you press (ENTER), the standard sample data settings will be deleted.

1. Scanning range
   Set the wavelength range over which the absorbance will be measured.
2. Rec. range
   Enter the range for the vertical axis when displaying the absorption spectrum on screen for a standard sample measurement or unknown sample measurement.
3. Scan speed (Fast, Medium, Slow, Very Slow)
   Set the wavelength scanning speed from among 4 levels.
4. Display mode
   Select whether to overlay absorption spectra for standards or unknown samples, or rewrite the spectrum for each measurement.

5. No. of components

Enter the number of components that comprise the mixed sample. The entry range is 2 to 8 components.

```
Multi-Component          500.0nm  0.000A
 1.Scanning range :  500 nm ~   400 nm
 2.Rec. range     :  0.00A  ~   2.00A
 3.Scan speed     : Medium
 4.Display mode   : Sequential
 5.No.of component: 8
 6.Standard type  : Mixed
 7.No.of Standard : 5  ← Change param.
 8.Meas. λ        :   Undefined
 9.Standard data  :   Undefined
Input item No.
BaseCorr            SmplCntl
```

Fig. 8.4 No. of components entry screen

The number of constituent components is related to both <6. Standard type> and <7. No. of Standard>.

If it becomes necessary to change the No. of standards because there has been a change in the No. of components, you will be instructed on screen to "Change param."

In addition, if <6. Standard type> is set to "Pure", <7. No. of Standard> will automatically be overwritten with the same number as the No. of components.

6. Standard type

Select a number to indicate whether the standard sample is a pure sample made from a single component or a mixed sample of known concentrations of more than one component.

7. No. of Standard

Enter the number of standard samples. If the standard is pure, the No. of standard samples will automatically be set to the same number as the No. of components.

When the standard sample is a mixed sample, the input range is (No. of components + 1) to 16.

8. Meas λ

Select the wavelength for measurement of standards and unknowns. The concentration of the sample will be calculated from the absorbance at specified measurement wavelengths in the spectrum.

```
Multi-Component
 No. WAVEL.   No. WAVEL.   No. WAVEL.
 1    500.0
 2    474.0
 3    448.0
 4    422.0

  Meas. λ Int.: 2h
Input measuring λ interval
(34~50, 0=Manual input)
```

Fig. 8.5 Measurement wavelength input screen

You can enter wavelengths by setting an equal interval using the starting wavelength (long wavelength) as a standard or by numerically entering any desired wavelength values. Key in the wavelength interval or the number of desired wavelengths and their values as instructed on the screen.

The input screen for entering desired wavelengths is shown below.

```
Multi-Component
 No. WAVEL.   No. WAVEL.   No. WAVEL.
 1    500.0
 2    474.0
 3    448.0

Input meas. λ
( 400.0~ 500.0) ScanPitch(nm):0.2
```

Fig. 8.6 Desired wavelength input screen

The numbers of wavelengths which can be specified are as follows.

For pure samples: Only the same number as (No. of components)

For mixed samples: (No. of components) ~ (No. of standard – 1)

When entering desired wavelengths, you cannot enter two or more of the same wavelength, or a wavelength that exceeds the scanning range.

You also may not enter a wavelength that does not align with the sampling pitch of the wavelength scan (displayed as ScanPitch (nm)).

(see Table 4.1 Data Sampling Interval in Chapter 4.)

If the entered wavelength is inappropriate, a message will be displayed inviting you to enter another wavelength.

Once you have set the measurement wavelengths, "Defined" will be displayed in <8. Meas. λ> of the parameter configuration screen.

9. Standard data

This allows you to enter the standard sample concentrations, after that to measure the standard sample absobance spectra.

This parameter is explained in "8.4 Measurement Standard Sample".

8. 4 Measurement Standard Samples

When you select <9. Standard data> in the parameter configuration screen, a standard sample concentration input screen will be displayed.

The standard sample concentrations are entered and the standard sample absorbance spectra are measured in this screen.

Parameters <1.> through <8.> must be set in the parameter configuration screen in order to measure the standard sample(s).

The concentration input screen differs slightly depending on whether the standard sample is pure or mixed.

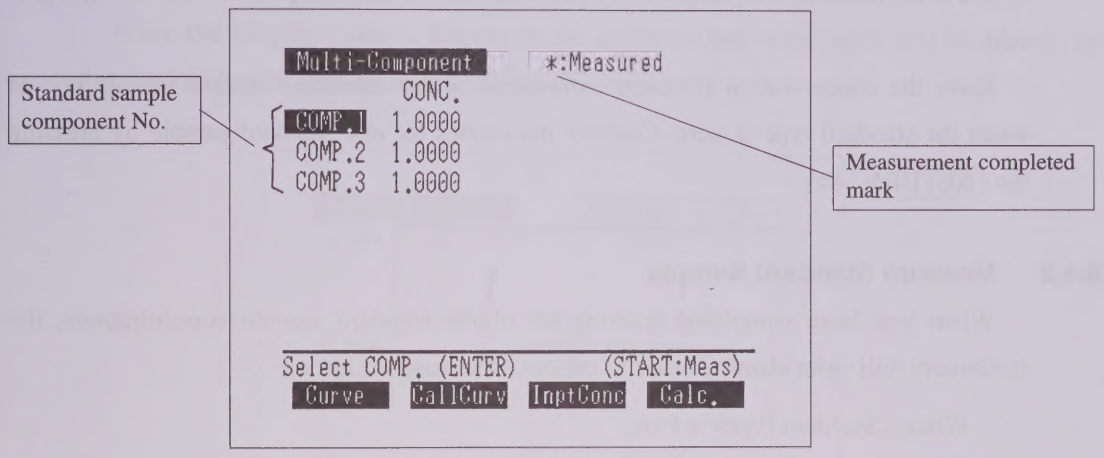

Fig. 8.7 Standard sample data input screen (Pure)

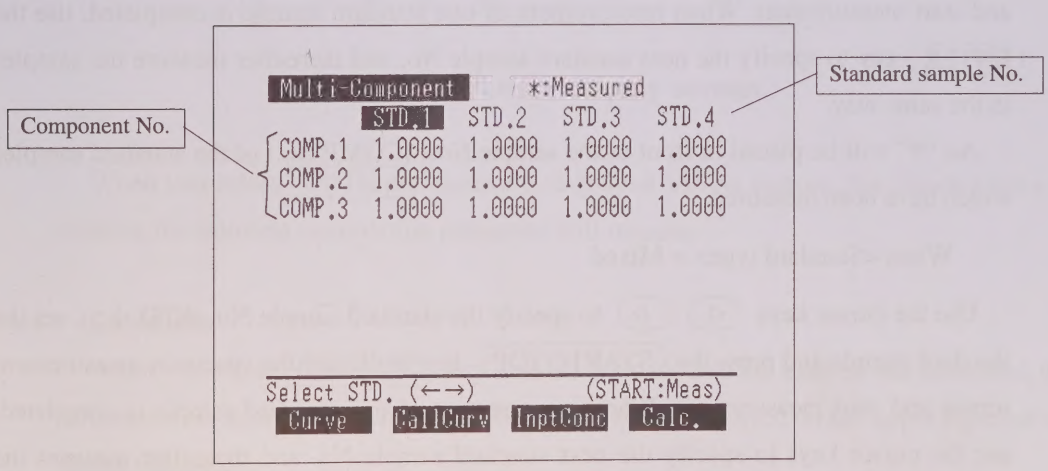

Fig. 8.8 Standard sample data input screen (Mixed sample)

8.4.1 Enter Concentration

When <Standard type> = Pure

When you select InptConc (F3) key, the concentration column (CONC.) for each standard (COMP. 1...) will be highlighted in order. Key in the concentrations in order as instructed on the screen. Confirm the entered concentration value with the (RETURN) key.

When <Standard type> = Mixed

Use the cursor keys (◁) (▷) to select the number of the standard sample (STD. 1...) whose concentration is to be entered. (The selected standard sample No. will be highlighted.)

Enter the concentration for each component of the selected standard sample just as when the standard type is pure. Confirm the entries for one standard sample by pressing the (RETURN) key.

8.4.2 Measure Standard Sample

When you have completed entering all of the standard sample concentrations, the instrument will enter standby mode to measure the standard sample.

When <Standard type> = Pure

Use the (ENTER) key to specify standard sample No. (COMP. 1...), set the standard sample and press the (START/STOP) key to display the spectrum measurement screen and start measurement. When measurement of one standard sample is completed, use the (ENTER) key to specify the next standard sample No. and thereafter measure the samples in the same way.

An "*" will be placed in front of the sample Nos. (COMP. 1...) of the standard samples which have been measured.

When <Standard type> = Mixed

Use the cursor keys (◁) (▷) to specify the standard sample No. (STD. 1...), set the standard sample and press the (START/STOP) key to display the spectrum measurement screen and start measurement. When measurement of one standard sample is completed, use the cursor keys to specify the next standard sample No. and thereafter measure the samples in the same way.

An "*" will be placed in front of the sample Nos. (STD. 1...) of the standard samples which have been measured.

CallCurv (F2) key

Whether the sample is pure or mixed, you can call up absorbance spectrum measured in the Spectrum mode which have already been saved in memory and use them as the standard sample data.

Specify the standard sample No. just as when performing measurement, and then call the spectrum from memory with CallCurv (See 2.3.2 Save Curve and Call Curve.

8.4.3 Display Curve

When you select Curve (F1) key, spectrum is display on the screen.

When the Display mode is Sequential,the spectrum measured latest will be display. In the case of Overlay, All measured spectra will be display.

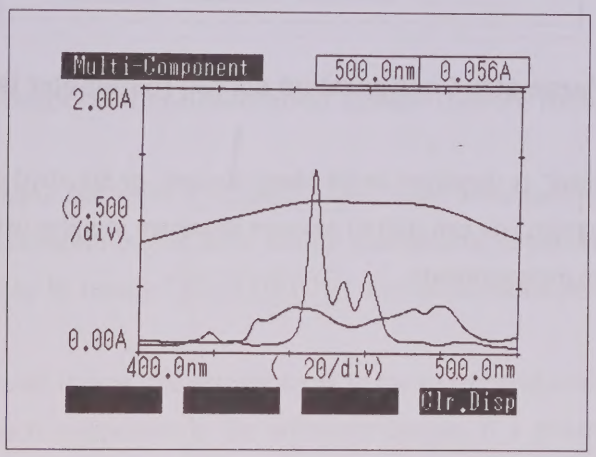

Fig. 8.9 Spectrum display screen

When you select Clr.Disp, Spectra is displayed will be cleared. But the data for calculating the isolation quantitation parameter still remains .

8.4.4 Calculate

When you select Calc. (F4) key after all standard data are entered and measured, the parameters for quantitation will be calculate. "Busy" is displayed on the upper right corner during calculation.

Note When you execute the calculation, the measured spectrum will be deleted.

The result of calculation is confirmed by entering (RETURN) key. After that Parameter Configuration screen will be displayed.

```
Multi-Component        500.0nm  1.172A
 1.Scanning range :  500 nm ~   400 nm
 2.Rec. range     :  0.00A  ~   2.00A
 3.Scan speed     : Medium
 4.Display mode   : Overlay
 5.No.of component: 3
 6.Standard type  : Mixed
 7.No.of Standard : 4
 8.Meas. λ        :   Defined
 9.Standard data  :   Defined
Input item No.            (START to Meas.)
BaseCorr            SmplCntl  MeasDisp
```

Fig. 8.10 Parameter Configuration screen (parameter is confirmed)

When "Defined" is displayed in <8.Meas. λ> and <9.Standard data> of the parameter configuration screen, you can start to measure unknown samples using the (START/STOP) key and perform measurements.

8.5 Measurement of Unknown Sample

After you finish setting quantitation parameters, push MeasDisp (F4) key to switch the measurement parameter configuration screen into the component concentration screen.

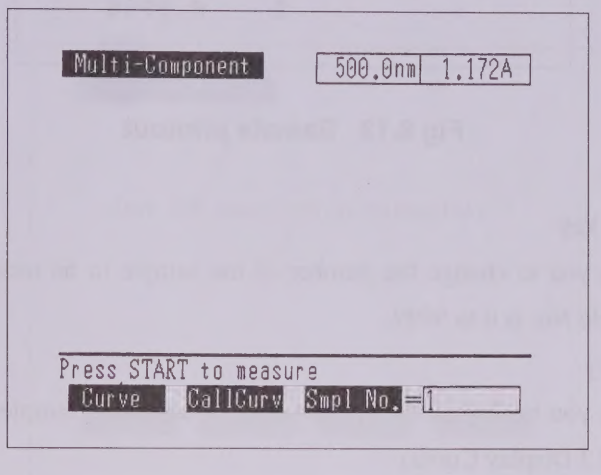

Fig 8.11 Component concentration screen (before measurement)

Set an unknown sample and press (START/STOP) key. Then the spectrum display screen comes up and the measurement begins.After setting quantitation parameters are completed, you can start the measurement by hitting (START/STOP) key in the measurement parameter configuration screen.

When the measurement is over, the display turns to the component concentration screen, and the concentration of each component in the unknown sample. If a printer is connected to the instrument, the result is printed out automatically.

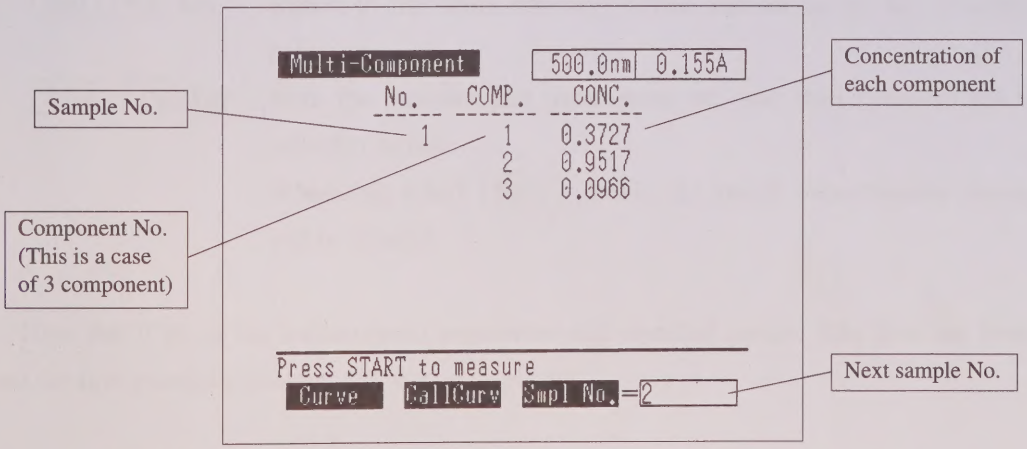

Fig 8.12 Component concentration screen (after measurement)]

```
No.      COMP.     CONC.
------ -------- --------
  1        1     0.3727
           2     0.9517
           3     0.0966
```

Fig 8.13 Sample printout

Smpl No. (F3) key

This allows you to change the number of the sample to be measured next. The input range for sample No. is 0 to 9999.

Curve (F1) key

This allows you to display the spectrum of an unknown sample which has been measured. (See 8.4.3 Display Curve)

CallCurv (F2) key

This allows you to call up the spectrum of an unknown sample which has been saved in memory and perform quantitation. (See 8.4.2 Measure Standard Sample)

8. 6 Saving the Data on Standard Samples

When you press the (RETURN) key, the screen returns to the parameter configuration screen.

Furthermore, when you press the (MODE) key, the screen for saving measurement parameters and standard sample data is displayed.

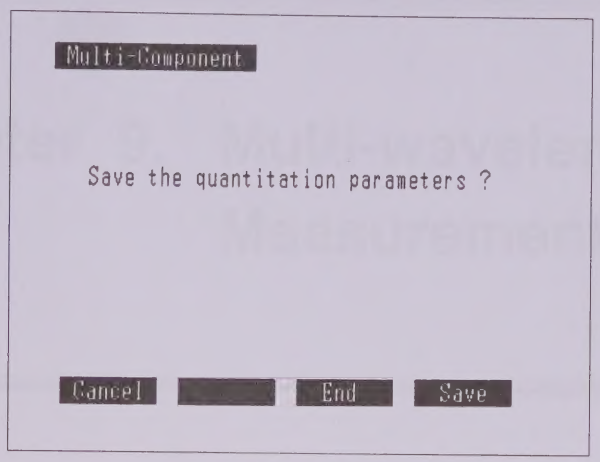

Fig.8.14 Save parameter screen

Only one set of measurement parameters and standard sample data can be saved in a different memory area from the measurement parameters of other measurement modes.

(Standard sample data which are saved are only those data which are required for multi-component quantitation. Spectra cannot be saved.)

[Cancel] (F1) key : Return to the parameter configuration screen without saving the measurement parameters, etc.

[End] (F3) key : Return to the mode selection screen without saving the measurement parameters, etc.

[Save] (F4) key : Save the measurement parameters, etc. and then return to the mode selection screen.
When you select [Save], previously stored measurement parameters will be deleted.

Note that if all of the measurement parameters and standard sample data have not been set, and the save parameters screen will not be displayed.

Chapter 9. Multi-wavelength Measurement Mode

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9.1 Multi-wavelength Measurement

The multi-wavelength measurement mode allows you to specify a maximum of eight arbitrary wavelengths and then measure the absorbance or transmittance at those wavelengths. It is also possible to select one of the following three equations based on the data obtained at four wavelengths maximum and then output the calculation results:

1) Ratio and difference between the photometric values at two wavelengths; and calculation at three wavelengths
2) Calculation of equation based on four data pieces $(K1 \times A1 + K2 \times A2 + K3 \times A3 + K4 \times A4) \times K5$
3) Calculation of equation based on four data pieces $K5 \times (K1 \times A1 + K2 \times A2)/(K3 \times A3 + K4 \times A4)$

   where An (n = 1~4) stands for absorbance at measurement wavelength λn (n = 1~4).

- Two-wavelength calculation

  The ratio and difference between the photometric values at two wavelengths are calculated. This processing is applicable for eliminating the effect of any interfering component (difference), scattering due to turbidity, and floating of the baseline due to the production of small bubbles, and for evaluating the purity (ratio) (→ 5.4.1 Two-wavelength Quantitation).

- Three-wavelength calculation

  This processing is performed as follows (→ 5.4.2 Three-wavelength Quantitation):

  $A2 - Ad$ (where $Ad = (\lambda1-\lambda2) \times A3 + (\lambda2-\lambda3) \times A1)/(\lambda1-\lambda3)$

  The three-wavelength calculation is also applicable for eliminating the effect of any interfering component, and floating of the baseline that has slanted due to turbidity or any other reason.

- Four-data equation calculation

  This processing is performed as follows:

  $(K1 \times A1 + K2 \times A2 + K3 \times A3 + K4 \times A4) \times K5)$; or

  $(K5 \times (K1 \times A1 + K2 \times A2)/(K3 \times A3 + K4 \times A4))$

  where K1~K5 are coefficients (arbitrary numbers are to be entered) and A1~A4 are absorbance.

  For the calculation of this equation, the measurement wavelengths and coefficients may be specified freely. In addition, A1~A4 can be measured while selecting different samples. This provides high versatility.

Note The absorbance at each wavelength is measured up to the lower digit than the displayed lowest one. For the calculation at two or three wavelengths, this data is used. This means that the calculation results at two or three wavelengths may differ from those obtained by the manual calculation using the value displayed at each wavelength. In this case, assume that the values for the calculation results displayed on the screen of the UV-1700 are correct.

9. 2 Parameter Configuration screen

When <7. Photometric (Multiλ)> is selected on the Mode Selection screen, the Parameter Configuration screen appears.

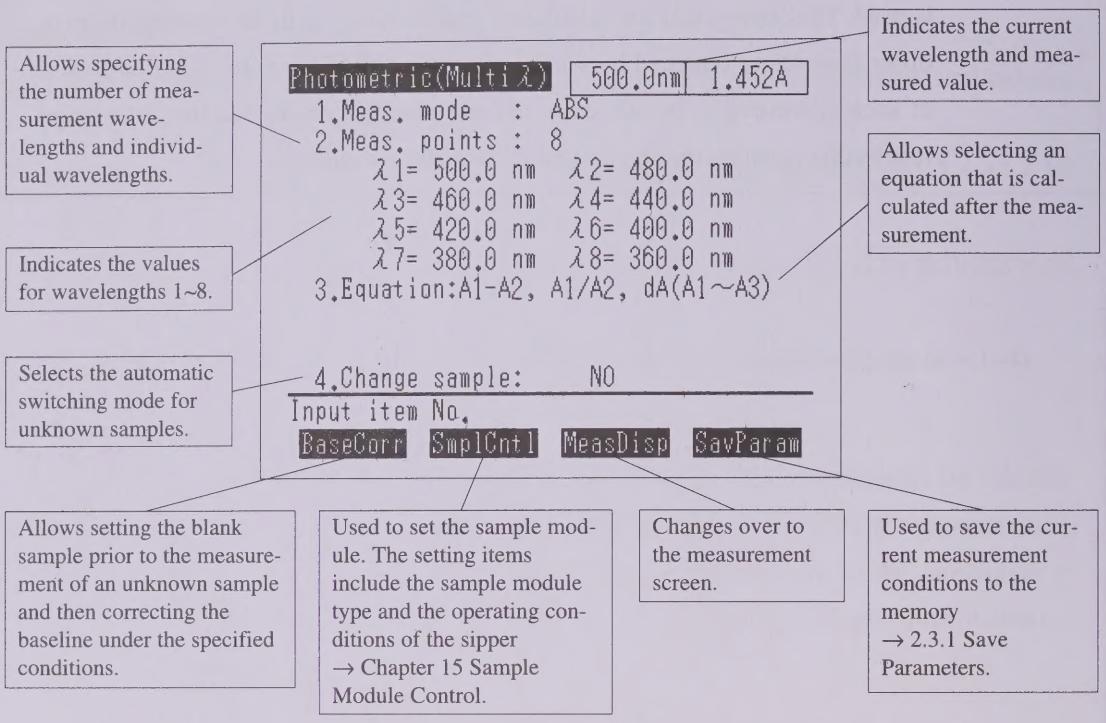

Fig. 9.1 Parameter Configuration screen

Note Updating the measurement screen

The information on the measurement screen will be updated as measurement runs are performed. If any parameter is changed, e.g., in an equation after the measurement, the previous measurement result and parameters remain on the measurement screen.

To change any parameter on the Parameter Configuration screen, enter the corresponding item number.

(1) Meas. mode (measurement mode)

Entering this item number will toggle the mode between ABS and T%.

(2) Meas. points (measurement wavelengths)

The number of measurement wavelengths can be entered in a range between 1 and 8. Subsequently enter values for wavelengths λ1~λn (n stands for an integer up to 8) by that number, in a range between 190.0 and 1,100.0 nm.

The measurement will be carried out in the order of λ1, λ2, ... λn.

When all the data has been entered, the UV-1700 automatically goes to λ1.

(3) Equation

One of the following equations can be selected. The calculation is performed using the equation that has been selected after the measurement, and then the result is displayed. If the Meas. mode is set to transmittance, only the measurement result at each wavelength will be displayed without performing the calculation.

Equation 1: A1–A2, A1/A2

$$dA\ (A1{\sim}A3) = A2 - ((\lambda1-\lambda2) \times A3 + (\lambda2-\lambda3) \times A1)/(\lambda1-\lambda3))$$

Equation 2: (K1A1 + K2A2 + K3A3 + K4A4) * K5

Equation 3: K5 * (K1A1 + K2A2) / (K3A3 + K4A4)

where:

An (n = 1~4) stands for the measured value for absorbance at measurement wavelength λn (n = 1~4).

Kn is a coefficient, which can be specified in a range between -9999.9 and 9999.9. Specify Kn after selecting equation 2 or 3.

```
Equation
  Equation:
    1.A1-A2, A1/A2, dA(A1~A3)
    2.(K1A1+K2A2+K3A3+K4A4)*K5
    3.K5*(K1A1+K2A2)/(K3A3+K4A4)

  K1=  1.0000  K2=  2.0000  K3=  0.5000
  K4=  0.5000  K5=  0.2500

Input No. of equation.
```

Fig. 9.2 Equation screen

Note If the number of measurement wavelengths does not meet the number of wavelengths in the equation for the multi-wavelength measurement, the calculation will be performed assuming that the absorbance at the non-measurement wavelength is zero.

(4) Changing the sample at each wavelength

Specify whether or not to change the sample whenever the measurement is performed at each wavelength. The available options are described below:

1. None

The sample is not changed at each wavelength. The same sample is measured at all the wavelengths specified in "Number of measurement wavelengths". If the sample module selected in "Sample control" is Multi-cell, the sample in each cell is measured at all the wavelengths by automatically changing the sample to the specified number of cells.

Shown below as an example is the measurement flow chart of the case in which "6-cell" is selected, the number of measurement wavelengths is set to 3, and the number of cells used is set to 3:

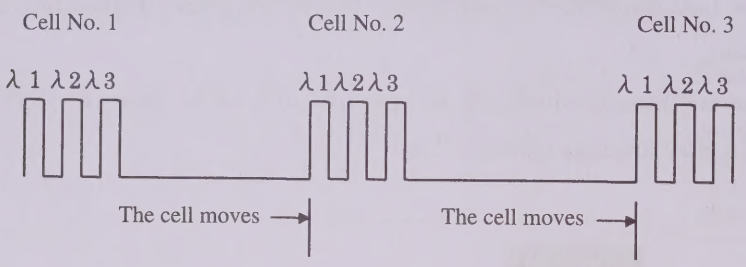

Fig. 9.3 Measuring operation

2. Manual (single-cell)

This mode is used to change the sample at each measurement wavelength. Change the sample after the measurement at one wavelength, press the (START/STOP) key according to the message displayed on the screen, and then proceed to the next measurement.

In this case, the (START/STOP) key cannot be used to abort the measurement and the (RETURN) key must be used for this purpose.

3. Auto (multi-cell)

After the measurement at one wavelength, the multi-cell is automatically moved to change the sample. The maximum number of selectable cells is six. The number of cells used is automatically set to the number of measurement wavelengths. The sample module must be set to Multi-cell. This mode is not available for the sipper unit.

Shown below as an example is the measurement flow chart of the case in which 6-cell is selected and the number of measurement wavelengths is set to 3:

Note

1. If "Auto (multi-cell)" is selected, the sipper unit cannot be used.
2. To abort the measurement, press the (START/STOP) key. In this case, the measurement will be resumed starting at measurement wavelength λ1 when the (START/STOP) key is pressed again.

9.3 Measurement screen

Pressing the MeasDisp (F3) key or the (START/STOP) key in the Parameter Configuration screen, the measurement screen appears as shown in Fig. 9.5. When the (START/STOP) key is pressed, the measurement will be performed and the measured value and the calculation result will be displayed. If the specified number of wavelengths does not meet the required number for the calculation, the calculation will be performed assuming that the absorbance at the non-specified wavelength is zero.

To abort the measurement, press the (START/STOP) key. The aborting operation occurs after the wavelength has been changed. In this case, the result is not displayed and no data is printed out.

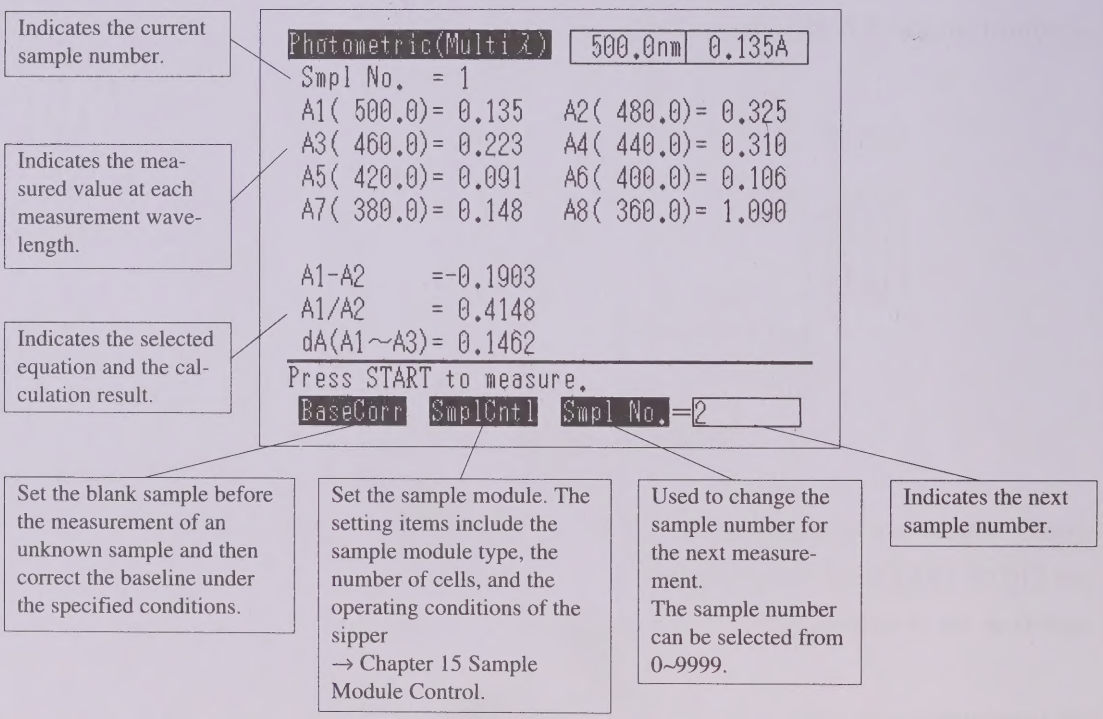

Fig. 9.5 Measurement screen

9.4 Measurement Data and Calculation Result

After the measurement, the calculated values are displayed on the screen according to the specified equation and then printed out on the printer. Fig. 9.6 shows the Meas. screen (displaying the result) and a printout sample from the optionally available printer (DPU) connected.

The sample number, absorbance (A1~A8) at each wavelength, the values for the difference and ratio between A1 and A2, and the calculation result of dA (A1~A3) are displayed simultaneously.

Fig. 9.7 shows the case in which the Meas. mode is T%.

```
No. =     1
A1(  500.0 nm )=  0.135
A2(  480.0 nm )=  0.325
A3(  460.0 nm )=  0.223
A4(  440.0 nm )=  0.308
A5(  420.0 nm )=  0.090
A6(  400.0 nm )=  0.106
A7(  380.0 nm )=  0.149
A8(  360.0 nm )=  1.093
      A1 - A2  = -0.1901
      A1 / A2  =  0.4144
  dA(A1,A2,A3)=  0.1460
```

Fig. 9.6 Measurement screen (ABS; equation: A1-A2, A1/A2, dA(A1~A3)) and printout from (DPU)

```
No. =     1
T1(  500.0 nm )=   73.4
T2(  480.0 nm )=   47.3
T3(  460.0 nm )=   59.9
T4(  440.0 nm )=   49.1
T5(  420.0 nm )=   81.1
T6(  400.0 nm )=   78.3
T7(  380.0 nm )=   71.0
T8(  360.0 nm )=    8.1
```

Fig. 9.7 Measurement screen (T%) and printout from (DPU)

Fig. 9.8 shows the measurement screen (displaying the result) in the case where the Meas. mode is set to ABS and the equation to (K1A1+K2A2+K3A3+K4A4) × K5, and the printout from the optionally available printer (ESC/P-24) connected.

The sample number, absorbance (A1~A8) at each wavelength, and the calculation result from (K1A1+K2A2+K3A3+K4A4) × K5 are displayed simultaneously.

```
WL/nm     500.0    480.0    460.0    440.0    420.0    400.0    380.0    360.0
 No.        A1       A2       A3       A4       A5       A6       A7       A8
-----------------------------------------------------------------------------
   1      0.134    0.324    0.223    0.308    0.090    0.106    0.149    1.095
                                                                RESULT =  0.2622
   2      0.134    0.324    0.222    0.308    0.090    0.106    0.150    1.098
                                                                RESULT =  0.2620
```

Fig. 9.8 Measurement screen (ABS; equation: (K1A1+K2A2+K3A3+K4A4) × K5) and printout from (ESC/P-24)

When the data is output to the printer, the same data is also output to the RS-232C port. The data output format is the same as in the output example for each printer. At the end of each line, the CR (0Dh) and LF (0Ah) codes are output.

The transmission specification for the RS-232C port is as shown below:

Baud rate	: 9,600 bps
Data bit length	: 7
Stop bit	: 1
Parity	: Odd number
X parameter	: None

For the connection cable, see “14.1 Connecting to a PC”.

Chapter 10. Optional Program Pack

The UV-1700 can employ new functions using the optional program pack (IC card).

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10.2 Optional Program Pack Auto-start 10-3

10. 1 Starting the Optional Program Pack

Insert the optional program pack into the IC card slot in the right side of the UV-1700 chassis and then select <8. Optional Program Pack> in the mode selection screen to display the measurement parameters screen of the optional program.

If the optional program pack is not inserted properly, the messages "No valid pack" or "No valid program pack" "Insert program pack then press 'ENTER'" will be displayed.

Check that the IC card is properly inserted and that it is the program pack, and then perform the above operation again.

10. 2 Optional Program Pack Auto-start

If the parameter, Start program is set to "Optional Program Pack", the optional program pack inserted into the IC card slot will be automatically started with the Parameter Configuration screen displayed after the power has been turned ON and subsequently the initialization has been completed.

Chapter 11. Data Processing

The data processing function can be used from the measurement screen in the Spectrum mode or the Time Scan mode (one-cell measurement). This function allows you apply the following processing options to the measured waveform data:

- Arithmetic calculation (CH operation*)
- Derivative processing (including smoothing)
- Peak detection
- Area calculation
- Point pickup

* In this mode, files in which curve data are saved can be expressed with CH (channels).

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11.3 Derivative processing/Smoothing processing (Derivative) 11-7
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11.5 Area calc. 11-13
11.6 Point pick 11-15

11.1 Processing Options screen

Pressing DataProc the (F2) key on the measurement screen in the Spectrum mode or the Time Scan mode (one-cell measurement), the Processing Options screen appears.

The last measured data is displayed and can be processed. To process the data that is already stored in the memory or the data pack, call the corresponding file using the Call Curve function. (Multiple waveforms cannot be displayed simultaneously on the Data Processing screen.)

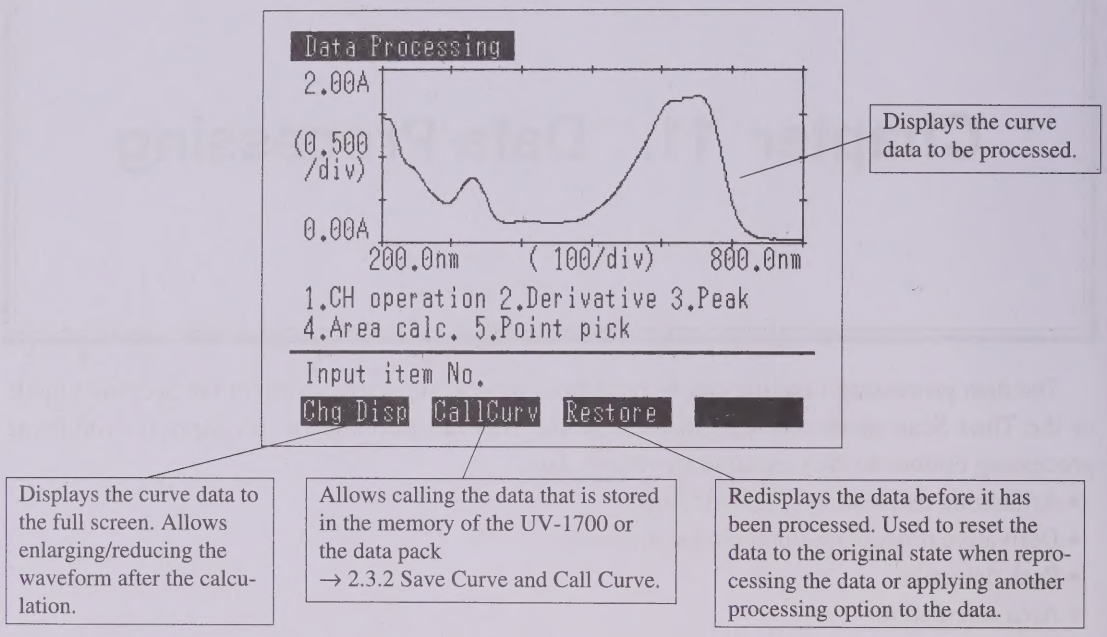


Fig. 11.1 Processing Options screen

To select a processing option, enter the corresponding item number.

(1) CH operation

Allows performing the arithmetic operations between curve data and values and those between curve data. However, no data can be calculated if the unit is inconsistent between the vertical and horizontal axes.

(2) Derivative

Applies the 1st to 4th order differential operation or smoothing to the curve data.

(3) Peak

Detects the peaks or valleys of the curve data and then displays them as a list of values on the vertical and horizontal axes. Up to 20 peaks or valleys can be detected.

(4) Area calc.

Calculates the area enclosed by the curve data and the horizontal axis.

(5) Point pick

Displays, as a list, values on the vertical axis against the horizontal axis at arbitrary or constant intervals of the curve data. Up to 20 points can be displayed.

11.2 Arithmetic Operations (CH Operation)

This option allows you to perform the arithmetic operations between curve data and values or those between curve data. When "1. CH operation" is selected on the Processing Options screen, the CH Operation screen appears.

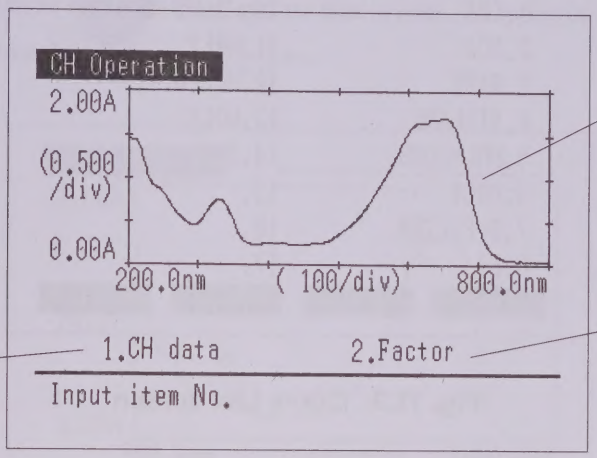


Fig. 11.2 CH Operation screen

(1) CH data

This option allows you to perform the arithmetic operations (+, −, ×, and ÷) between the curve data displayed (called) on the Processing Options screen and that contained in the specified file number.

If the range of the horizontal axis is different between the two curve data sets, the arithmetic operations are performed on the overlapping part of the two ranges. For example, the arithmetic operations between absorbance data at 500~600 nm and absorbance data at 550~650 nm are performed in the range between 550 and 600 nm and then the results are displayed. When the data sampling interval is different between the two curve data sets, the data obtained at the larger sampling intervals is interpolated in compliance with the data obtained at the smaller sampling intervals before the arithmetic operations have been performed. However, no arithmetic operations can be performed on data that uses inconsistent units between the vertical axis (ABS, T%, and E) and the horizontal axis (nm, sec, and min).

When "1. CH data" is selected, the Curve List screen appears.

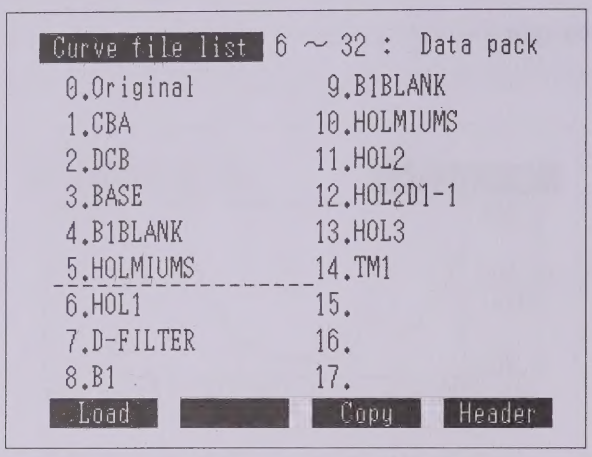


Fig. 11.3 Curve List screen

Specify curve data using a file number by performing the same operation as in the Call Curve function (2.3.2 Save Curve and Call Curve). The specified curve data will be displayed on the screen and the file name will appear in the second term of the equation (Fig. 11.4).

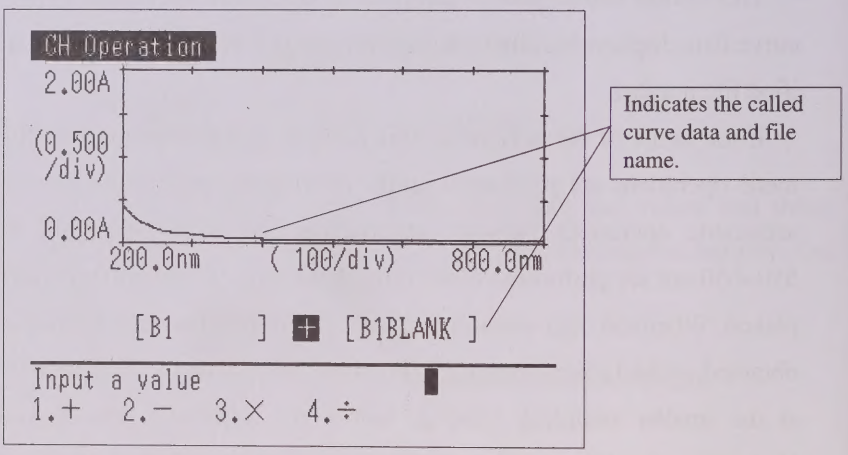
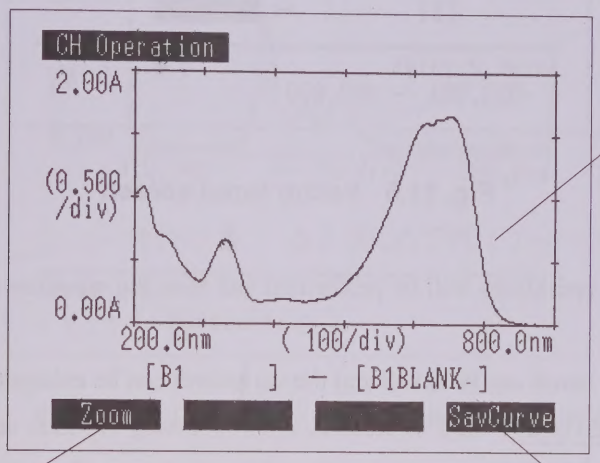


Fig. 11.4 Operation Symbols screen

When an arithmetic operation symbol is selected, operations between curve data are performed and then the equation and result are displayed (Fig. 11.5). The processing result can be saved and the waveform can be enlarged/reduced.

Pressing the (RETURN) key, the Processing Options screen appears again, but the curve data for the calculation result is displayed on that screen. To redisplay the data before it has been processed, press the [Restore] (F3) key.



Displays the processed curve data.

Allows enlarging/reducing the waveform after the arithmetic operations have been performed.

Allows saving the waveform after the arithmetic operations have been performed, as curve data in the memory of the UV-1700 or the data pack
→ 2.3.2 Save Curve and Call Curve.

Fig. 11.5 Calculation Result screen

(2) Factor

This option allows you to perform the arithmetic operations (+, −, ×, and ÷) between the curve data and values that have been displayed (called) on the Processing Options screen.

When Factor is selected, the Factor Input screen appears (Fig. 11.6). Enter a value and then select an arithmetic symbol.

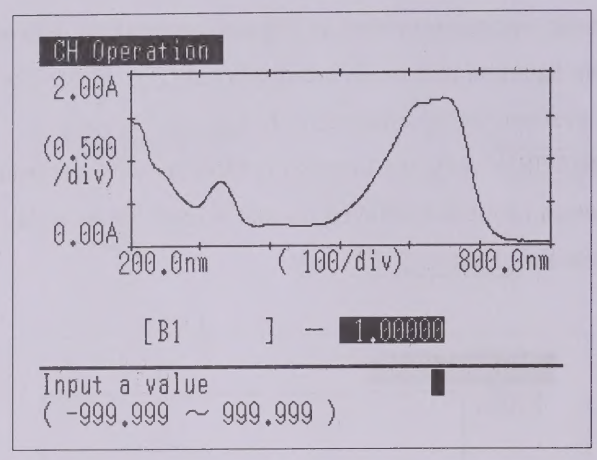


Fig. 11.6 Factor Input screen

The arithmetic operations will be performed and then the equation and result will be displayed (Fig. 11.7).

The processing result can be saved and the waveform can be enlarged/reduced.

When the (RETURN) key is pressed, the Processing Options screen appears, but the curve data for the calculation result is displayed on that screen. To redisplay the data before it has been processed, press the [Restore] (F3) key.

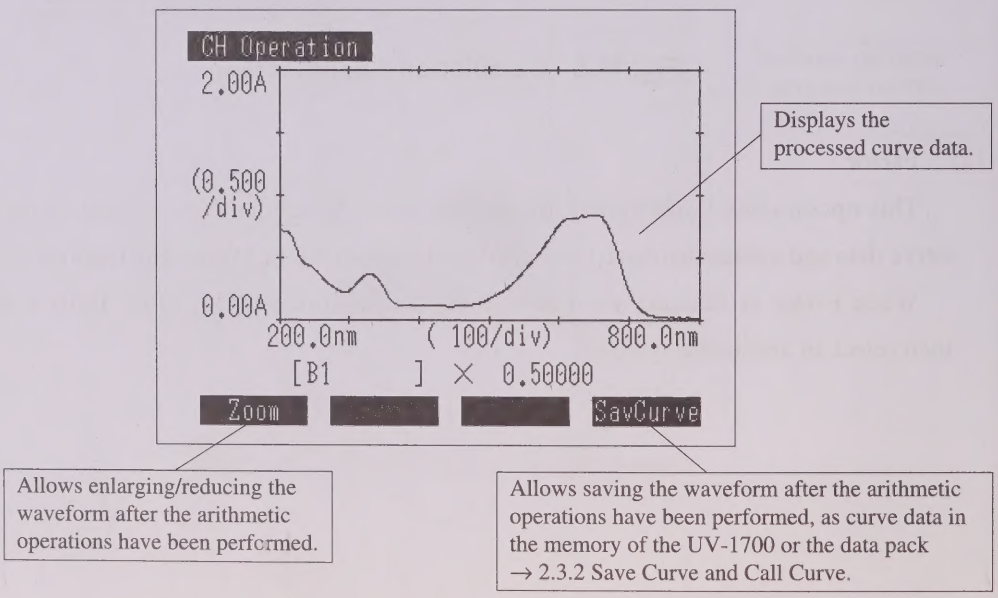


Fig. 11.7 Calculation Result screen

11.3 Derivative processing/Smoothing processing (Derivative)

For the curve data, the 1st to 4th order derivative processing or smoothing can be performed. For this derivative processing, the digital derivative operation by the convolution method using 17 data pieces consisting of the former and latter data (Savitzky-Golay method) has been adopted.

When "2: Derivative" is selected on the Processing Options screen, the Derivative processing screen appears.

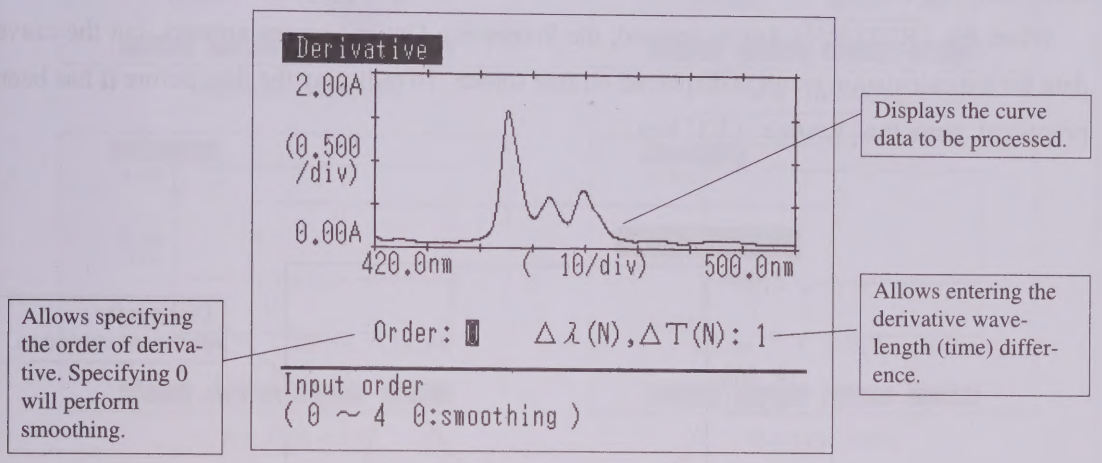


Fig. 11.8 Derivative processing screen

Enter the coefficient Δλ (N) (ΔT (N)) that determines the order of derivative and the derivative wavelength (time) difference, according to the message displayed on the screen.

To specify the order of derivative, select one from 0 through 4. When 0 is specified, smoothing will be performed.

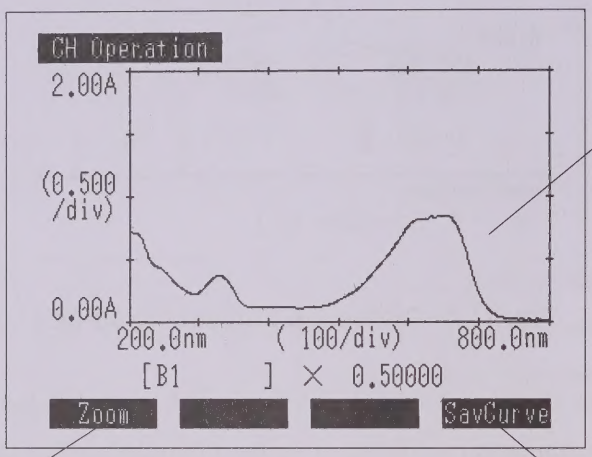
For N in the coefficient Δλ (N) (ΔT (N)), enter a value in a range between 1 and 9. The derivative wavelength (time) difference will be determined by the measurement wavelength range and the keyed-in value for N. Tables 11.1 and 11.2 show the relation between the two. In general, as Δλ (ΔT) becomes larger, noises decrease. However, if it becomes excessively larger, the resolution of the derivative spectrum deteriorates. Considering the two elements, noises and the resolution, determine Δλ (ΔT).

Note Values at both ends of derivative spectrum

The derivative values at both ends of the curve data are processed as follows. In order to calculate the derivative values for each data set, 17 data pieces consisting of the former and latter data are used. However, no data required for the calculation is available at both ends of the curve data. For this reason, the edging data is repeatedly used for the calculation.

When the coefficient N is entered, the differentiation is performed and then the result is displayed. Fig. 11.9 shows the result obtained by processing the data in Fig. 11.8 with the order of 1 and the coefficient N of 1 ($\Delta\lambda$ = 0.8). Fig. 11.10 shows the changes in the derivative spectrum that occur when $\Delta\lambda$ is different. The processing result can be saved and the waveform can be enlarged/reduced.

When the (RETURN) key is pressed, the Processing Options screen appears, but the curve data for the calculation result is displayed on that screen. To redisplay the data before it has been processed, press the [Restore] (F3) key.



Displays the processed curve data.

Allows enlarging/reducing the waveform after the arithmetic operations have been performed.

Allows saving the waveform after the arithmetic operations have been performed, as curve data in the memory of the UV-1700 or the data pack → 2.3.2 Save Curve and Call Curve.

Fig. 11.9 Calculation Result screen

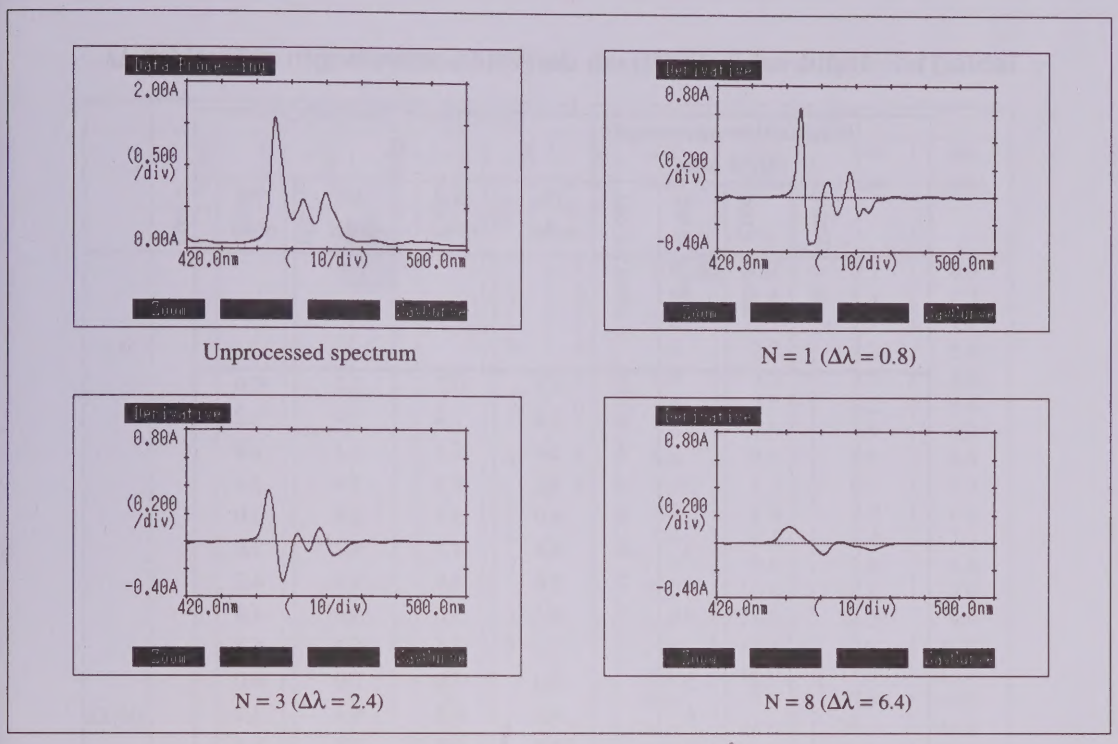


Fig. 11.10 Changes in derivative spectrum depending on derivative wavelength difference

Table 11.1 Input value Δλ (N) vs. derivative wavelength difference Δλ

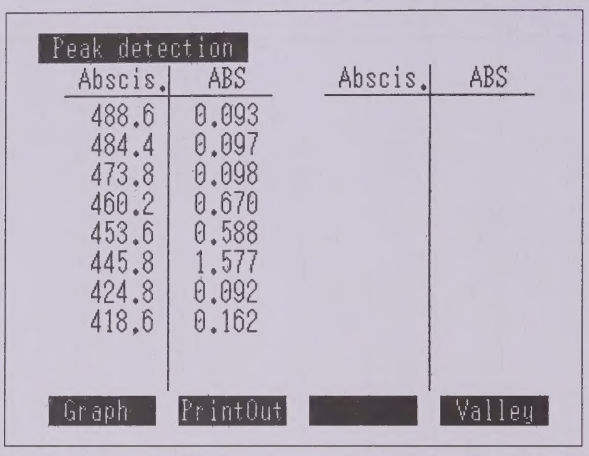
	Measurable wavelength range (nm)				Δλ			
	λ range> 500	500 ≧ λ range > 200	200 ≧ λ range > 100	100 ≧ λ range	1st order	2nd order	3rd order	4th order
				1	0.8	0.7	0.7	0.6
			1	2	1.6	1.4	1.4	1.2
				3	2.4	2.1	2.1	1.8
			2	4	3.2	2.8	2.8	2.4
		1		5	4.0	3.5	3.5	3.0
			3	6	4.8	4.2	4.2	3.6
				7	5.6	4.9	4.9	4.2
			4	8	6.4	5.6	5.6	4.8
				9	7.2	6.3	6.3	5.4
	1	2	5		8.0	7.0	7.0	6.0
			6		9.6	8.4	8.4	7.2
			7		11.2	9.8	9.8	8.4
		3			12.0	10.5	10.5	9.0
Δ λ(N)			8		12.8	11.2	11.2	9.6
			9		14.4	12.6	12.6	10.8
	2	4			16.0	14.0	14.0	12.0
		5			20.0	17.5	17.5	15.0
	3	6			24.0	21.0	21.0	18.0
		7			28.0	24.5	24.5	21.0
	4	8			32.0	28.0	28.0	24.0
		9			36.0	31.5	31.5	27.0
	5				40.0	35.0	35.0	30.0
	6				48.0	42.0	42.0	36.0
	7				56.0	49.0	49.0	42.0
	8				64.0	56.0	56.0	48.0
	9				72.0	63.0	63.0	54.0

Table 11.2 Input value ΔT (N) vs. derivative time difference ΔT

	RECORDING TIME(SEC)							ΔT(SEC)			
	6500 ≧ T > 5000	5000 ≧ T > 2000	2000 ≧ T > 1000	1000 ≧ T > 500	500 ≧ T > 200	200 ≧ T > 100	100 ≧ T ≧ 10	1st order	2nd order	3rd order	4th order
							1	0.8	0.7	0.7	0.6
						1	2	1.6	1.4	1.4	1.2
							3	2.4	2.1	2.1	1.8
						2	4	3.2	2.8	2.8	2.4
					1		5	4.0	3.5	3.5	3.0
						3	6	4.8	4.2	4.2	3.6
							7	5.6	4.9	4.9	4.2
						4	8	6.4	5.6	5.6	4.8
							9	7.2	6.3	6.3	5.4
				1	2	5		8.0	7.0	7.0	6.0
						6		9.6	8.4	8.4	7.2
						7		11.2	9.8	9.8	8.4
					3			12.0	10.5	10.5	9.0
						8		12.8	11.2	11.2	9.6
						9		14.4	12.6	12.6	10.8
			1	2	4			16.0	14.0	14.0	12.0
					5			20.0	17.5	17.5	15.0
Δλ(N)				3	6			24.0	21.0	21.0	18.0
					7			28.0	24.5	24.5	21.0
			2	4	8			32.0	28.0	28.0	24.0
					9			36.0	31.5	31.5	27.0
		1		5				40.0	35.0	35.0	30.0
			3	6				48.0	42.0	42.0	36.0
				7				56.0	49.0	49.0	42.0
			4	8				64.0	56.0	56.0	48.0
				9				72.0	63.0	63.0	54.0
	1	2	5					80.0	70.0	70.0	60.0
			6					96.0	84.0	84.0	72.0
			7					112.0	98.0	98.0	84.0
		3						120.0	105.0	105.0	90.0
			8					128.0	112.0	112.0	96.0
			9					144.0	126.0	126.0	112.0
	2	4						160.0	140.0	140.0	120.0
		5						200.0	175.0	175.0	150.0
	3	6						240.0	210.0	210.0	180.0
		7						280.0	245.0	245.0	210.0
	4	8						320.0	280.0	280.0	240.0
		9						360.0	315.0	315.0	270.0
	5							400.0	350.0	350.0	300.0
	6							480.0	420.0	420.0	360.0
	7							560.0	490.0	490.0	420.0
	8							640.0	560.0	560.0	480.0
	9							720.0	630.0	630.0	540.0

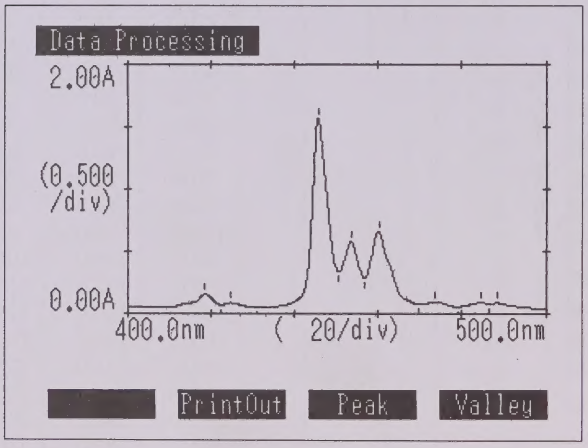
11.4 Peak detection

This detects the peaks or valleys in the curve data displayed in the processing item selection screen and displays a list of the results. When selecting [Peak] or [Valley], the peak table shown in Fig. 11.11 is changed over. Up to 20 peaks, valleys can be detected.



(Peak table)

Fig. 11.11 Peak detection screen (peak table)



Peak/valley mark
(Peak/valley marks)

Fig. 11.12 Peak detection screen

When selecting [Graph] in the Peak detection screen, the curve data with the mark indicating peaks and valleys will be displayed. When you press the (RETURN) key on the Peak detection screen, the data before peak detection (without mark) will be displayed.

When the [PrintOut] (F3) key is pressed, the horizontal axis for peaks and valleys and the corresponding vertical axis are output to the printer and the RS-232C port.

11.5 Area calc.

This calculates the area bounded by the curve and the horizontal axis.

When you select <4. Area calc.>, the area calculation screen will be displayed (Fig. 11.13)

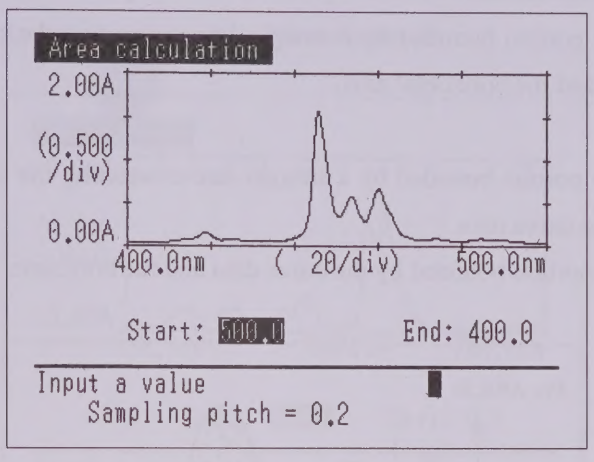


Fig. 11.13 Area calculation screen

Enter the horizontal range over which the area will be calculated according to the instructions on the screen.

Press one of the ◁ ▷ keys to display a cursor. While the cursor is displayed, you can specify the start point or end point by moving the cursor and pressing (ENTER).

When you enter the range, the calculation will be executed and the result displayed. (Fig. 11.14)

If the value at the start (or end) point does not match up with a sampling point, the calculation will be performed between the nearest sampling points in the outside of the specified range.

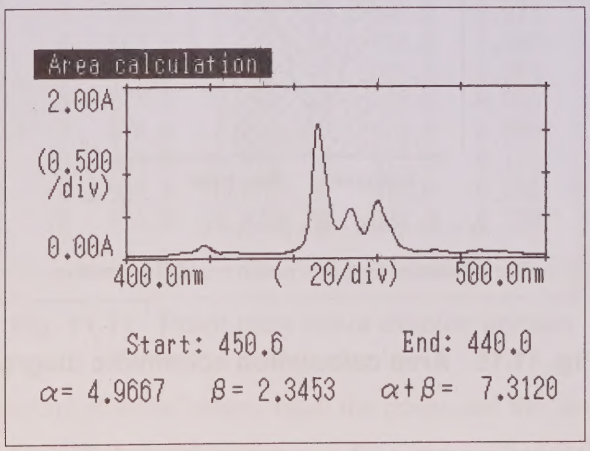


Fig. 11.14 Calculation results display screen

The calculation results are expressed as the values for α, β and α + β. For ABS, E:

α = the area of the portion bounded by the curve data and a straight line connecting the start and end points on the data

β = the area of the portion bounded by a straight line connecting the start and end points on the curve data and the horizontal axis.

For T%:

α = the area of the portion bounded by a straight line connecting the start and end points on the data and the curve data

β = the area of the portion bounded by the curve data and the horizontal axis.

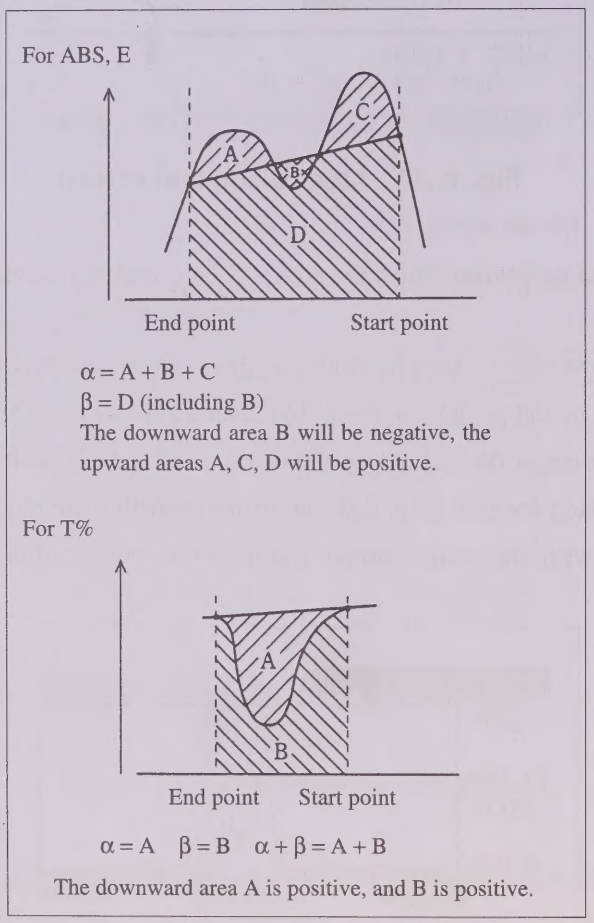


Fig. 11.15 Area calculation schematic diagram

Press the (RETURN) key to return to the processing item selection screen.

11.6 Point pick

This will display a list of ordinate data for up to 20 points at a specified interval from a specified abscissa (wavelength, time). Inputting "–" for the start point of abscissa enables the ordinate data corresponding to up to 20 points of arbitrary abscissa values to be displayed.When you select <5. Point pick>, the point pick screen will be displayed.

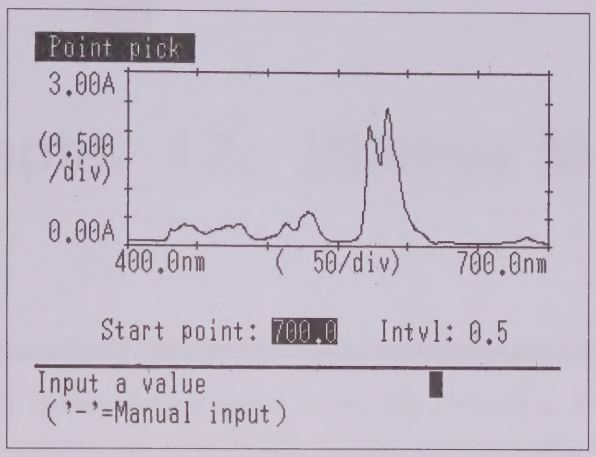


Fig. 11.16 Point pick screen

Enter the starting abscissa (maximum limit of wavelength or minimum time) and the interval according to the instructions on the screen. An example is shown in which the start wavelength is 500nm and the interval is 5nm.

Point pick

Abscis.	Ordinat.		Abscis.	Ordinat.	
1	700.0	0.080	11	650.0	0.071
2	695.0	0.094	12	645.0	0.072
3	690.0	0.131	13	640.0	0.075
4	685.0	0.177	14	635.0	0.080
5	680.0	0.132	15	630.0	0.094
6	675.0	0.104	16	625.0	0.093
7	670.0	0.094	17	620.0	0.083
8	665.0	0.079	18	615.0	0.131
9	660.0	0.072	19	610.0	0.255
10	655.0	0.070	20	605.0	0.339

Fig. 11.17 Point pick value display screen

When arbitrarily inputting abscissa values, input the points and the abscissa values for those points according to the instruction on the screen.

Press the (RETURN) key to return to the processing item selection screen.

Chapter 12. Utilities Mode

This is the mode for setting the instrument's operating parameters, such as the light source switching wavelength, printer setup or the number of data columns displayed.

The parameters which can be set in this mode are parameters which are shared with other modes.

These will also be stored internally, even if the power is turned OFF.

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12. 1 Utilities Menu Screen

When you select <9. Utilities> in the mode selection screen, the utilities menu shown in Figure 12.1 will be displayed.

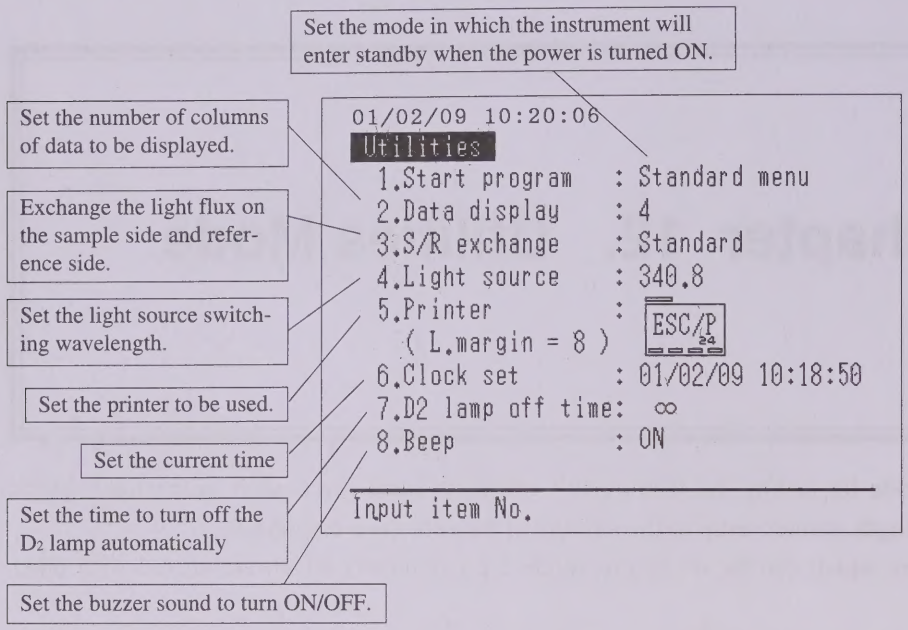

Fig. 12.1 Utilities menu screen

1. Start program

This function determines the mode in which the instrument will be in after the power is turned ON and initialization is completed. Select the item with the cursor key ◁ or ▷ .

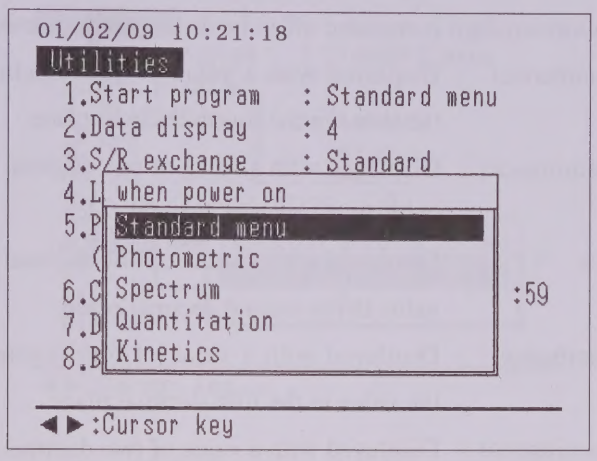

Fig. 12.2 Start program selection screen

(1) Standard menu

The instrument is set to this mode for shipping. The mode selection screen will be displayed when the power is turned ON.

(2) Photometric, Spectrum, Quantitation, Kinetics, Time Scan, Multi-Component, and Multi-wavelength

The instrument will stand by at the parameter configuration screen of the selected mode.

(3) Optional program pack

The program pack inserted in the slot will automatically start. If the program pack is not properly inserted into the slot, the messages "No valid pack" or "No valid program pack" "Insert program pack then press 'ENTER'" will be displayed.

(4) Stored param. file

The measurement parameter file stored in instrument memory and set here will be called up and the instrument will go to standby.

Saving Measurement Parameters...

Save measurement parameters to a file by pressing the [SavParam] function key in the measurement parameter configuration screen for the respective mode.

See "2.3.1 Save Parameters" for more details.

(5) PC control

The instrument automatically goes to the PC control mode. (See 14 PC control)

2. Data display

You can switch the number of digits of photometric data display between 4 and 5.

A value at the minimum digit is rounded off to be displayed or printed out.

4 : ABS (Absorbance)	:	Displayed with a value of three ducimal places. Round off the value in the fourth decimal place.
T% (Transmittance)	:	Displayed with a value of one ducimal places. Round off the value in the second decimal place.
E (Energy)	:	Displayed with a value of one ducimal places. Round off the value in the second decimal place.
5 : ABS (Absorbance)	:	Displayed with a value of four ducimal places. Round off the value in the fifth decimal place.
T% (Transmittance)	:	Displayed with a value of two ducimal places. Round off the value in the third decimal place.
E (Energy)	:	Displayed with a value of two ducimal places. Round off the value in the third decimal place.

Note For an operation based on each measurement value, the internal data (data before being rounded off) in the floating-point format is used.
The displayed data has been rounded off. Therefore, the value manually calculated based on the photometric data is different from one resulted from the operation; the fewer the number of significant digits is, the larger the difference is.

3. S/R exchange

This allows you to exchange the sample side light flux with the reference side light flux. When set to "Standard", the front of the sample compartment will be the sample light flux and the back will be the reference light flux. When set to "Reverse", the front of the sample compartment will be the reference light flux and the back will be the sample light flux. "Reverse" is used when special accessories are installed. "Standard" is normally used.

4. Light source

The UV-1700 uses an ultraviolet deuterium lamp (D2 lamp) and a visible-nearinfrared tungsten-iodine lamp (WI lamp). The switching wavelength for these two lamps is set to 340.8nm at the time of shipping, but it can be set to any value between 295.0 and 364.0nm.

5. Printer setting

The printer to be connected is selected and the format of a hard copy is set.

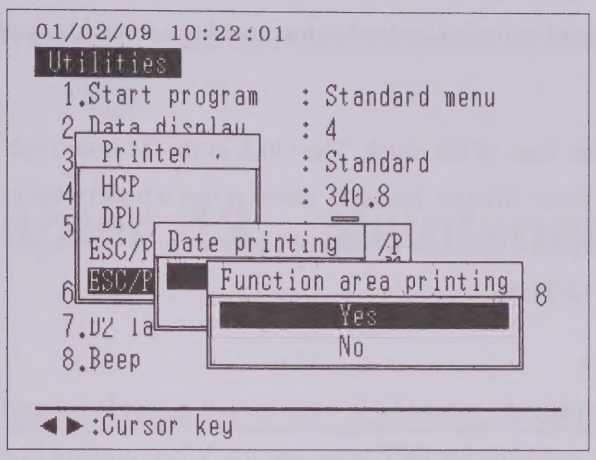

Fig. 12.3 Printer selection screen

(1) Following four types of printers can be connected.

HCP

Set this when the screen copy printer HPC-1series (option) is being used.

DPU

Set this when the DPU-414 printer (option) is being used.

ESC/P9

Set this when using a printer that supports the ESC/P control code for EPSON 9-pin printers.

ESC/P24

Set this when using a printer that supports the ESC/P control code for EPSON 24-pin printers.

This is also applied for laser printers.

When selecting ESC/P9 and ESC/P24, the left margin can also be set. The setting range is from 0 to 9.

Note	If you do not properly select the printer type, the printer will not operate properly.

(2) Date printing

Set this whether the date should be printed in the hard copy output.

(3) Function area printing

Set this whether the region to display function keys should be output in a hard copy.

6. Clock set

Use this to set the time of the clock. The clock is the 24-hour type and is set in the order (Year/Month/Date Hour: Minute: Second). Since it has a battery back-up, it is not necessary to set the clock every time you turn ON the power.

Ex.) 10/Dec/94 12:34:56

7. D2 lamp off time

D2 lamp is automatically turned OFF when measurement is not performed. The following 4 kinds of time are available for OFF timer setting. When nothing is executed during the set time, the lamp is turned OFF.

10 min, 30 min, 60 min, ∞

8. Beep

Set this to turn ON/OFF of the buzzer.

Chapter 13. Maintenance

The UV-1700 provides the validation function that is used to validate its performance and the maintenance function that is used to manage the time periods of lamp illumination and the dates when the instrument baseline was corrected.

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13. 1 Maintenance screen

When the Mainte. (F3) key is pressed on the Mode selection screen used to select each measurement mode, the Maintenance screen appears.

The Maintenance screen allows you to check the dates when the instrument baseline was corrected and the time periods of lamp illumination at the current point.

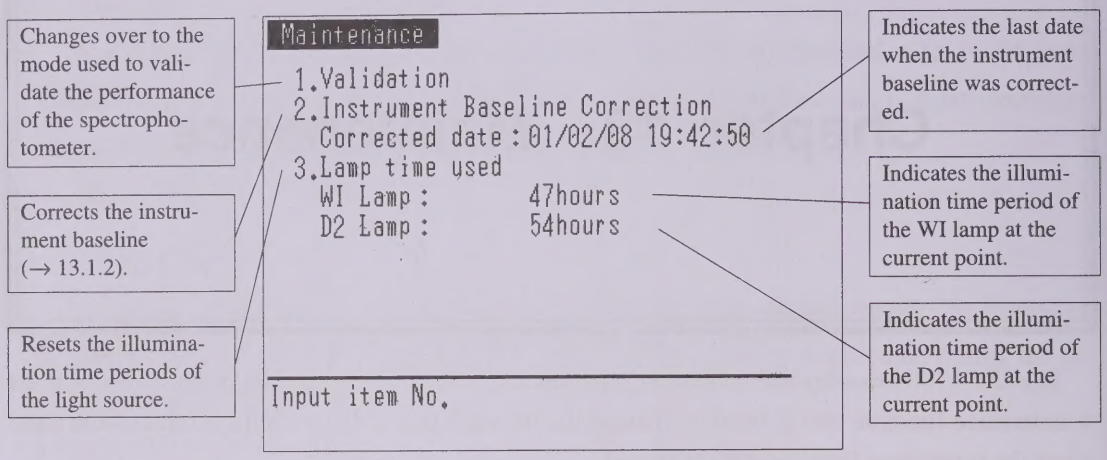


Fig. 13.1.1 Maintenance screen

> **Note** The time periods of lamp illumination displayed on the Maintenance screen show the illumination time periods as of the point when the screen has been displayed. Therefore, they will not be updated if the screen remains unchanged (will be updated when the screen is redisplayed).

13.1.1 Validation

This maintenance option is used to periodically validate the performance of the UV-1700 and record the result. When this item is selected (by pressing the ① key), the Validation Menu appears. Now press the (START/STOP) key. The selected item will be validated. For further information on the validated items and operation procedures, see "13.2 Instrument Validation".

13.1.2 Instrument Baseline Correction

The UV-1700 provides the instrument baseline correction option in addition to the normal baseline correction option. The former option is intended to correct the optical balance of the UV-1700 itself, allowing you to correct and store the baseline at shorter intervals.

The stored correction data will be used to correct the baseline in each measurement mode. For this reason, in each measurement mode, the baseline is corrected at longer intervals in the specified wavelength range, but even a slight optical imbalance can be corrected within a short time.

This correction allows you to eliminate steps and shock noises in such a short time, which have never been removed by the conventional baseline correction unless it is made at the same intervals as data acquisition during the measurement.

<Executing the instrument baseline correction>

Select <2. Instrument Baseline Correction> on the Maintenance screen (Fig. 13.1.1) (by pressing the ② key). The instrument baseline correction will be started. It will take approximately 15 minutes to complete the correction. To abort the correction, press the (START/STOP) key. In this case, "Not corrected" will be displayed in the Corrected date field of the Maintenance screen (Fig. 13.1.1).

When the instrument baseline correction is completed successfully, the date is displayed in the Corrected date field.

Note The display format in the Corrected date field is as specified in <12. Utilities>/<6. Clock set> on the Mode selection screen.
Aborting the instrument baseline correction, some problem might occur with the data to be acquired. When the instrument baseline correction is aborted for any reason, settle the problem and then make sure of making the instrument baseline correction again.

13.1.3 Lamp time used

On the Maintenance screen, the illumination time periods of the halogen (WI) lamp and the deuterium (D_2) lamp used for the UV-1700 are displayed. The displayed time periods show the illumination time periods as of the point when the screen has been displayed. Therefore, they will not be updated if the screen remains unchanged (will be updated when the screen is redisplayed).

<Reset the time record>

When <3. Lamp time used> is selected on the Maintenance screen (by pressing the ③ key), the following message appears at the bottom of the screen. Now the illumination time period of each lamp can be reset.

```
Reset the time record.
1)WI Lamp  2)D2 Lamp
```

Fig. 13.1.2 Resetting the lamp illumination time record

To reset the illumination time record of the WI lamp, press the ① key. To reset that of the D_2 lamp, press the ② key. Then press the (ENTER) key. The illumination time record of the selected lamp will be reset and "0 hour" will be displayed on the Maintenance screen (Fig. 13.1.1). The illumination time period will restart now.

Note The validation parameters, the dates of baseline correction, and the lamp illumination records are stored in the RAM of the UV-1700. When the UV-1700 is OFF, the data in the RAM is retained using the built-in backup battery. Therefore, if the battery is replaced or if the data in the RAM is deleted, partially or wholly, all of the above records are lost.

13. 2 Instrument Validation

The UV-1700 allows you to validate nine items of its performance (measurement, evaluation, and result print) using the Validation function. Table. 13.2.1 shows a list of validation items. For details of each validation item, see 13.2.5 "Detail of validation items".

Table 13.2.1 List of validation items

Items	Description
Photometric Accuracy	The optical filter for transmittance calibration is measured (absorbance or transmittance) and then the deviation of the measured values from the standard values for calibration (standard values) that are indicated on the filter is used for the evaluation. For the validation, the calibrated two types of filters (transmittance: approx. 10%T and 30%T) are used.
Photometric repeatability	The optical filter for transmittance calibration is used to measure the photometric value (absorbance or transmittance) at an arbitrarily specified wavelength three times. The mean value is obtained and then the deviation of the measured values from that mean value is used to evaluate the results. For this validation, the calibrated two types of filters (transmittance: approx. 10%T and 30%T) are used.
Stray light	Stray light is represented by the ratio of the sum of light intensity at wavelengths other than the specified one to the intensity of light coming from the monochromator at the specified wavelength. For this validation, the transmittance of a solution of sodium iodine (10 g/*l*), a solution of sodium nitrite (50 g/*l*), or the UV-39 filter is measured at 220 and 340 nm. The obtained values are defined as stray light values at those wavelengths and used to evaluate the validation result.
Wavelength Accuracy (D2 lines)	Emission line radiated from the deuterium (D_2) lamp used as the light source for the UV-1700 is measured, and then the deviation from the emission line wavelength is used to evaluate the validation result.
(Optical filter)	The optical filter for wavelength calibration is measured, and then the deviation from the reference wavelength indicated on the filter is used to evaluate the validation result.
Wavelength repeatability	Emission line radiated from the deuterium (D_2) lamp used as the light source for the UV-1700 is measured three times.The mean value is obtained, and then the deviation of the measured values from that mean value is used to evaluate the results.
Resolution	Emission lines radiated from the deuterium (D_2) lamp used as the light source are measured. The half-value width (spectrum bandwidth) of the obtained spectral waveform for the emission lines is defined as the resolution, and this value is evaluation.

Items	Description
Baseline stability	The time changes around absorbance of 0 Abs are measured and then the measured change per hour is defined as baseline stability. The value for baseline stability is evaluated.
Baseline flatness	The baseline is corrected without a sample. Immediately after the correction, the wavelengths are scanned. The curvature of the spectrum obtained at that time is defined as baseline flatness, and this value is evaluated.
Noise level	The time changes around the absorbance of 0 Abs at the wavelength specified are measured for 1 minute, and the deflection of the absorbance at that time is defined as noise level (P-P). The RMS value is obtained from the measurement for 1 minute and then both of these values are evaluated.
Initialization record	Print out the record which the UV-1700 is initialized and various self-diagnostics are performed every power ON.

Select <1. Validation> on the Maintenance screen. The Main screen for instrument validation will appear.

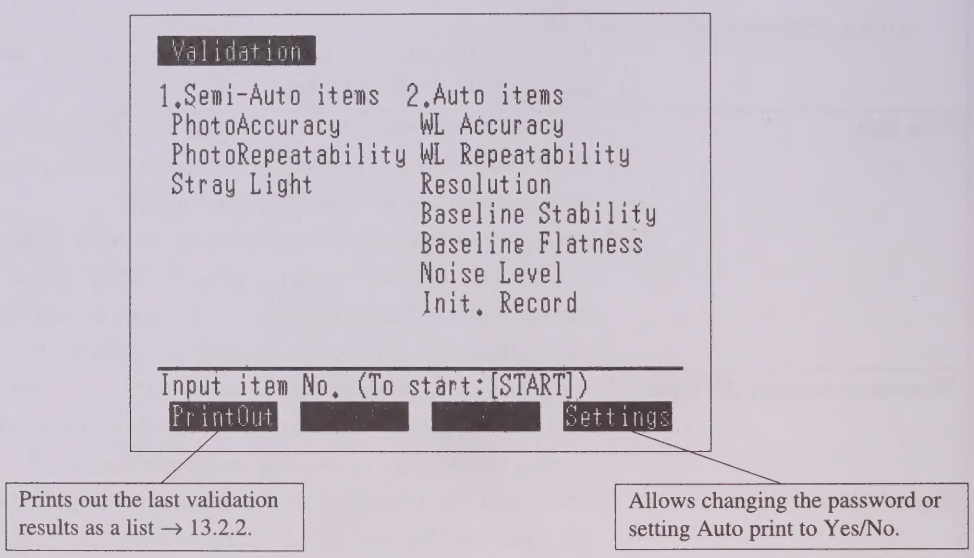


Fig. 13.2.1 Main screen for instrument validation

When the (START/STOP) key is pressed on the Main screen for instrument validation, the validation for the selected items (highlighted) is started.

This validation requires the following validation products (reagents) according to the validation items and related techniques:

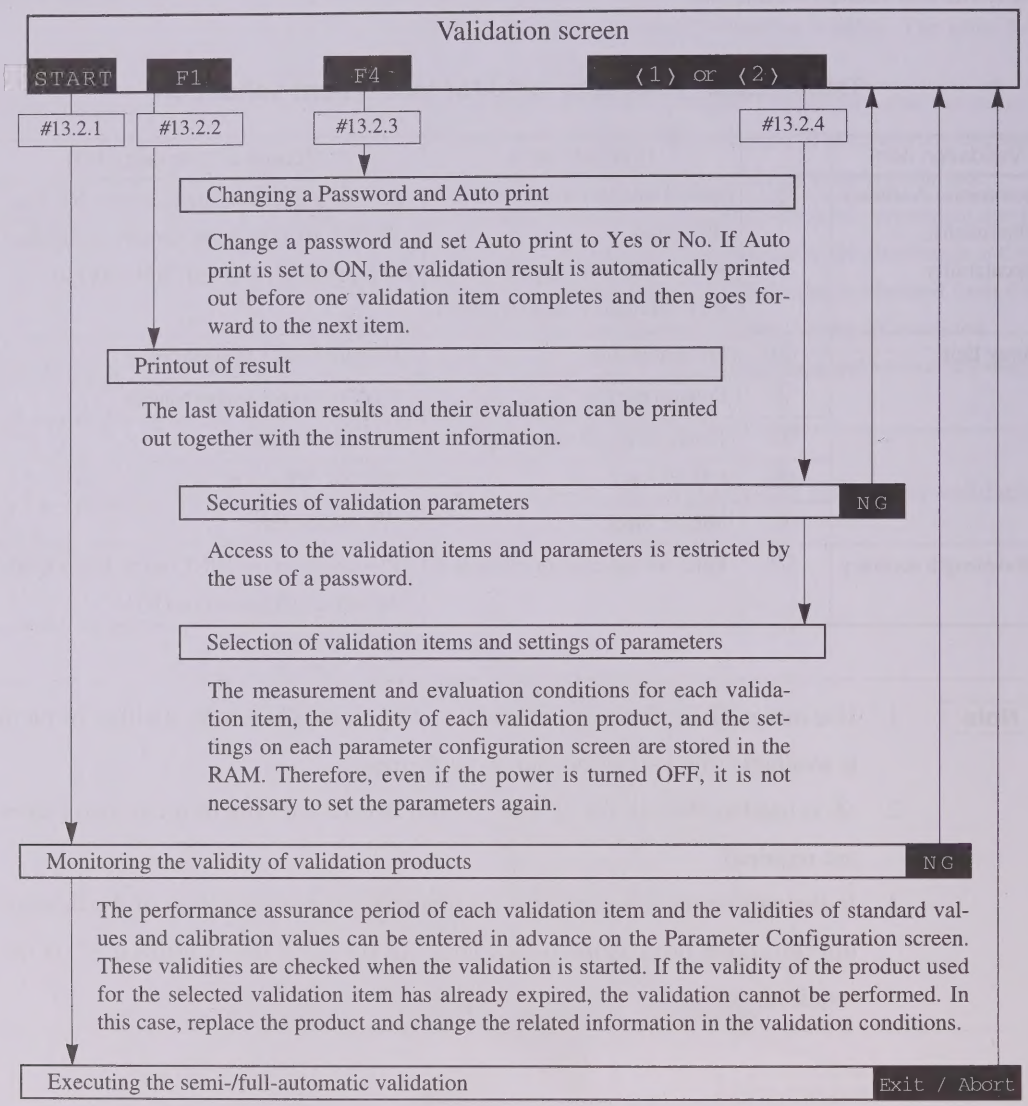
Table 13.2.2 Products used for instrument validation

Validation item		Product name	Source or Shimadzu P/N
Photometric Accuracy / Photometric Repeatability	①	Optical filter for transmittance calibration • Transmittance: approx. 10%T • Transmittance: approx. 30%T	Procure a filter conforming to the NIST's SRM930d or the Japan Quality Assurance Organization's (JQA) JCRM 110/130.
Stray light	②	Sodium iodine	Procure from a reagent dealer.
	③	Sodium nitrite	Procure from a reagent dealer.
	④	10 mm cubic cell made of quartz	P/N 200-34442
	⑤	UV-39 filter	P/N 202-30242-06
	⑥	Shutter block	P/N 202-30338
Wavelength accuracy	⑦	Filter for wavelength calibration	Procure from the NIST or the Japan Quality Assurance Organization (JQA).

Note

1. Use either ③ or ⑤ for validating the stray light. Therefore, if either of them is available, the validation can be performed.
2. ④ is used as the cell for ② and ③. If it is used for both of them, two pieces are required.
3. In the validation of wavelength accuracy, if the emission lines of the deuterium (D_2) lamp used as the light source for the UV-1700 is utilized, ⑦ is not required.

Fig. 13.2.2 provides an overview of the instrument validation.



- The validation and keying-in operations can be performed interactively (semi-automatic validation).
- The sequence of performing the measurement, evaluating the result, and then proceeding to the next item is executed automatically (full-automatic validation).
- The measurement results and evaluation results are printed out after each validation item has been completed (Auto print → 13.2.3).)
- Even if the validation is aborted, the preceding results of the validation items that have been obtained up to this point are stored and can be printed out in batch (result printout → 13.2.2)

Fig. 13.2.2 Overview of instrument validation

13.2.1 Executing Instrument Validation

The performance validation is classified into the semi-automatic validation that requires a validation product and the full-automatic validation that is automatically carried out ranging from the measurement to the evaluation once it is started.

Since the semi-automatic validation is carried out interactively, the operator keys in data and adding or removing validation products in accordance with the messages displayed on the screen.

An example of executing the instrument validation is given below.

It describes the steps for validating "Photometric Accuracy", "Wavelength Accuracy", "Baseline Flatness", and "Initialization Record".

The validation parameters for the validation items executed here conform to those set in "13.2.4 Selecting a Validation Item and Changing the Parameters".

Screen display	Step	Description
Validation 1.Semi-Auto items 2.Auto items PhotoAccuracy WL Accuracy PhotoRepeatability WL Repeatability Stray Light Resolution Baseline Stability Baseline Flatness Noise Level Init. Record Input item No. (To start:[START]) PrintOut Settings	①	The titles of the items to be validated are highlighted. (In this example, "Photometric Accuracy", "Wavelength Accuracy", "Baseline Flatness" and "Initialization Record" are validated.)
	②	Press the (START/STOP) key.
The following message appears on the screen together with the wavelengths at which to measure photometric values, the standard values and tolerance for the 10% filter, and other information. Perform Baseline correction. Remove all from the cell holder and press [START].	③	Check the sample module in accordance with the displayed message and then press the (START/STOP) key. (If the (RETURN) key is pressed, the validation is aborted and the screen shown in step 1 appears again.)
The baseline is corrected. * If the (START/STOP) key is pressed, the correction is aborted and the screen shown in step 1 appears again.		
When the baseline is corrected, the following message appears: 10% Filter- Place in the cell holder, and press [START].	④	Insert the filter in accordance with the message and then press the (START/STOP) key. (If the (RETURN) key is pressed, the validation is aborted and the screen shown in step 1 appears again.)

Screen display	Step	Description
When the 10% filter is measured, the following message appears: 30% Filter- Place in the cell holder, and press [START].	⑤	Replace the message in accordance with the message and then press the (START/STOP) key. (If the (RETURN) key is pressed, the validation is aborted and the screen shown in step 1 appears again.)
The 30% filter is measured.		
If Auto print is set to ON, the result is printed out.		
The validation for wavelength accuracy starts and the following message appears: Remove all from the cell holder, and press [START].	⑥	Remove the filter in accordance with the message and then press the (START/STOP) key. (If the (RETURN) key is pressed, the validation is aborted and the screen shown in step 1 appears again.)
The validation for wavelength accuracy starts. WL Accuracy 2/3 654.2nm 0.4E Tolerance: ± 0.3 nm 100E (20.0 /div) 0E 650.0nm (2/div) 660.0nm * Measuring * To stop press STOP key	⑦	(If the (START/STOP) key is pressed, the measurement is aborted and the screen shown in step 1 appears again.)
If Auto print is set to ON, the result is printed out.) STD= 656.1 MEAS= 656.1 DELTA= 0.0		
The validation for baseline flatness starts. Baseline flatness 3/3 704.0nm 0.000A Tolerance: ± 0.002 ABS 0.01A (0.005 /div) -0.01A 190.0nm (100/div) 1100.0nm * Measuring * To stop press STOP key	⑧	(If the (START/STOP) key is pressed, the measurement is aborted and the screen shown in step 1 appears again.)

Screen display	Step	Description
When the measurement is completed, the result is displayed. Baseline flatness = 0.0000ABS		
If Auto print is set to ON, the result is output.		
If Auto print is set to ON, the initialization result records are printed out.		
The screen displayed in step ① appears again.		

13.2.2 Printing out Results

When the (F1) key is pressed on the Menu (Fig. 13.2.1) for instrument validation, the last validation results are printed out.

For example, if Photometric Accuracy, Wavelength Accuracy, and Baseline Flatness were validated last time, only their results are printed out.

The date when validation is completed

Shimadzu spectrophotometer model

Serial number

Header

Enter the operator name.

Version number of the built-in program (firmware) of the UV-1700

```
Date: 01/02/09 11:00:15
Name:
Instrument Name:
UV-Vis Spectrophotometer UV-1700
Instrument S/N: 002
ROM Version:1.00

Photometric Accuracy:          OK
Measurement Mode: Abs

10% Filter
S/N:          110
Tolerance: +-0.008Abs
WL/nm       STD        MEAS      delta
635.0       1.039      1.0396    0.0006
590.0       1.063      1.0642    0.0012
546.1       1.005      1.0062    0.0012
465.0       1.008      1.0084    0.0004
440.0       1.136      1.1373    0.0013

30% Filter
S/N:          130
Tolerance: +-0.008Abs
WL/nm       STD        MEAS      delta
635.0       0.545      0.5465    0.0015
590.0       0.553      0.5543    0.0013
546.1       0.524      0.5259    0.0019
465.0       0.535      0.5356    0.0006
440.0       0.622      0.6218   -0.0002

Wavelength Accuracy:           OK
Tolerance: +-0.3nm
STD     MEAS    Delta
656.1   656.1    0.0
486.0   486.1   -0.1

Baseline Flatness:             OK
Tolerance: +-0.002Abs
Baseline Flatness =  0.0000Abs

Initialize Results:
   LSI INITIALIZE                  : OK
   MEMORY ROM CHECK                : OK
   MEMORY RAM CHECK                : OK
   FILTER MOTOR INITIALIZE         : OK
   LIGHT MOTOR INITIALIZE          : OK
   SCAN MOTOR INITIALIZE           : OK
   WI ENERGY CHECK                 : OK
   WAVELENGTH ORIGIN 1 SEARCH      : OK
   D2 ENERGY CHECK                 : OK
   WAVELENGTH ORIGIN 2 SEARCH      : OK
```

Fig. 13.2.3 Format for printing out results (when a screen hardcopy printer is used)

As to the result printout function, give attention to the following points:

- If no validation result exists, the printing operation itself is not performed.
- When the (START/STOP) key is pressed on the Menu (Fig. 13.2.1) for instrument validation (when the validation is started), the last obtained validation results are deleted.
- If the ongoing validation of multiple items is aborted by pressing the (START/STOP) key, the validation results that have been obtained up to that point are retained and therefore can be printed out.
- Only the validation result data is printed out. No spectrum and time-course curve are not printed out.
- The date in this printout is recorded when the validation was completed.

If a commercially available printer that supports ESC/P as control codes is used, the printout format differs from that of a screen hardcopy printer. If a ESC/P printer is selected as used, the left margin can be set in a range between 0 and 9.

To select a printer and then set it up, select <12. Utilities>/<5. Printer> on the Mode screen. (See "12.2 Setting Instrument Parameters".)

The result printout format of a printer supporting ESC/P is as shown below:

```
Date: 01/02/13 13:21:01
Name:
Instrument Name:        UV-Vis Spectrophotometer UV-1700
Instrument S/N: 002                              ROM Version:1.00

Photometric Accuracy:                                                    OK
   10% Filter                          30% Filter
   S/N:      110                       S/N:      130
   Tolerance: +-0.004Abs               Tolerance: +-0.002Abs
    WL       STD     MEAS    delta      WL       STD     MEAS    delta
    635.0    1.039   1.0402  0.0012     635.0    0.545   1.0402  0.0014
    590.0    1.063   1.0647  0.0017     590.0    0.553   1.0647  0.0014
    546.1    1.005   1.0068  0.0018     546.1    0.524   1.0068  0.0016
    465.0    1.008   1.0090  0.0010     465.0    0.535   1.0090  0.0006
    440.0    1.136   1.1379  0.0019     440.0    0.622   1.1379 -0.0003

Photometric Repeatability:                                               OK
   WL/nm: 635.0
   10% Filter                          30% Filter
   S/N:      110                       S/N:      130
   Tolerance: +-0.002Abs               Tolerance: +-0.001Abs
   M1       M2       M3       Ave.     M1       M2       M3       Ave.
    1.0402  1.0408   1.0408   1.0406    0.5465  0.5465   0.5465   0.5465
   -0.0004  0.0002   0.0002             0.0000  0.0000   0.0000

Stray:                                                                   OK
   NaI                                 NaNO2/UV-39
   S/N:      001                       S/N:      002
   Tolerance:   0.04%                  Tolerance:   0.04%
       0%   sample                         0%   sample
     0.000   0.012        0.012 %        0.000   0.000        0.000 %

Wavelength Accuracy:                                                     OK
   Tolerance: +-0.3nm
   STD     MEAS    Delta               STD     MEAS    Delta
   656.1   656.0   -0.1                486.0   486.0   0.0

Wavelength Repeatability:                                                OK
   Tolerance:  Ave.+-0.1nm
   M1       M2       M3       Ave.     M1       M2       M3       Ave.
   656.0    656.0    656.0    656.00   486.0    486.0    486.0    486.00
    0.00     0.00     0.00              0.00     0.00     0.00

Resolution:                                                              OK
   Tolerance: =<1.0nm
   Resolution =  0.72 nm

Baseline Stability:                                                      OK
   WL/nm: 700.0
   Tolerance:   0.0010Abs/H
   Baseline Stability =  0.0000Abs/H

Baseline Flatness:                                                       OK
   Tolerance: +-0.002Abs
   Baseline Flatness =  0.0001Abs

Noise Lavel:                                                             OK
   WL/nm: 700.0
   Tolerance: +-0.0020Abs              Tolerance: +-0.0002Abs
   P-P = 0.0000Abs                     RMS = 0.00000Abs
```

Fig. 13.2.4 Result print format (ESC/P)

13.2.3 Validation Options

When the (F4) key is pressed on the Main screen for instrument validation (Fig. 13.2.1), the Validation Options screen appears.

```
Settings
 1.Changing a Password
 2.Auto print:          OFF

Input item No.
```

Fig. 13.2.5 Validations Options screen

<1. Changing a password>

This option allows you to change the password that is required to change the validation conditions. Since the default value is "No password", specify a new password as follows:

Screen display	Step	Description
	①	Press the ① key on the screen shown in Fig. 13.2.5 (select "1. Changing a password")
Changing a password Old password ▮ New password Confirm the password Input Password. (0~9 Max.8-digit)	②	Enter the current password. The default value is "No password". If this is the case, press the (ENTER) key without entering anything.

Screen display	Step	Description
Changing a password Old password New password **** Confirm the password Input Password. (0~9 Max.8-digit)	③	Enter a new password (numeric characters). For example, to use "1234" as the password, press the ①, ②, ③, and ④ keys in this order. The entered characters will be displayed as ****. Check that the number of the entered digits is the same as the number of the displayed asterisks, and then press the (ENTER) key.
Changing a password Old password New password **** Confirm the password **** Input Password. (0~9 Max.8-digit)	④	Enter the new password again specified in step 2, and then press the (ENTER) key.
	⑤	If the passwords entered in steps ② and ④ are identical, the message "The password has been changed" appears and then the screen shown in step 4 is displayed again. If the (RETURN) key is pressed, the screen shown in Fig. 13.2.5 is displayed again without changing the password.

<2. Auto print>

When the ② key is pressed on the screen shown in Fig. 13.2.5, Auto print toggles between ON and OFF. If Auto print is set to ON, the result is printed whenever each validation option is completed. If a spectrum or time course is measured during the validation, the corresponding graph is also printed out (as a hard copy of the screen). For the printout format, see <13.2.5> that describe changing the parameters for each validation option.

Note

1) The printout format does not depend upon the printer. Therefore, the result is printed out in the same format on both a screen hardcopy printer and a commercially available printer (supporting ESC/P).
2) When a screen hardcopy printer is used with Auto print set to ON, the validation result cannot be printed out if the printer is set to OFF LINE. Therefore, you cannot proceed to the next validation item (in case of the full-automatic validation). In this case, set the printer to ON LINE.

13.2.4 Selecting a Validation Item and Changing the Parameters

Press the ① or ② key on the above Main screen and then enter the password. The Validation Options screen for the semi-automatic or full-automatic validation will appear.

```
Settings of Semi-Auto items

 1.Photometric Accuracy
 2.Photometric Repeatability
 3.Stray Light

Input item No. to change parameters.
```

```
Settings of Auto items

 1.Wavelength Accuracy
 2.Wavelength Repeatability
 3.Resolution
 4.Baseline Stability
 5.Baseline Flatness
 6.Noise Level
 7.Initialization Record

Input item No. to change parameters.
```

Fig. 13.2.6 Validation Options screen

Enter the validation item number for which you want to execute the validation or change the parameters. The corresponding validation parameters screen will appear.

An example of setting the validation parameters is given below.

It describes the steps for setting the validation items “Photometric Accuracy”, “Wavelength Accuracy”, “Baseline Flatness”, and “Initialization Record”.

Screen display	Step	Description
Validation 1.Semi-Auto items 2.Auto items PhotoAccuracy WL Accuracy PhotoRepeatability WL Repeatability Stray Light Resolution Baseline Stability Baseline Flatness Noise Level Init. Record Input item No. (To start:[START]) PrintOut Settings	①	Press the ① key on the Main screen for instrument validation (select "1. Settings of Semi-Auto items").
Setting of password Password: Input Password. (0~9 Max.8-digit)	②	Enter the password and then press the (ENTER) key. The default value is No password. If this is the case, press the (ENTER) key without entering anything. Enter a password.
Settings of Semi-Auto items 1.Photometric Accuracy 2.Photometric Repeatability 3.Stray Light Input item No. to change parameters.	③	Press the ① key to select "Photometric Accuracy".
Photometric accuracy 1.Inspection: Yes 2.Meas. mode: ABS 3.Check λ(nm): 635.0/ 590.0/ 546.1/ 465.0/ 440.0 4.10% Filter: S/N; 110 Good THRU;01/11/08 Tolerance;±8 mABS 5.30% Filter: S/N; 130 Good THRU;01/11/08 Tolerance;±8 mABS Input item No. Recomnd	④	Press the ① key to change "1. Inspection" from No to Yes. * Set the other parameters at your option (see 13.2.5 "1. Photometric Accuracy").

Screen display	Step	Description
	⑤	Press the (RETURN) key twice to go back to the screen in step ①.
Validation 1.Semi-Auto items 2.Auto items PhotoAccuracy WL Accuracy PhotoRepeatability WL Repeatability Stray Light Resolution Baseline Stability Baseline Flatness Noise Level Init. Record Input item No. (To start:[START]) PrintOut Settings	⑥	Press the ② key (select "2. Settings of Auto items") . * Since the validation item <Photometric Accuracy> is set to Yes in step ④, the title is highlighted.
Setting of password Password: Input Password. (0~9 Max.8-digit)	⑦	Enter the password and then press the (ENTER) key. * If no password has been specified, press the (ENTER) key without entering anything.
Settings of Auto items 1.Wavelength Accuracy 2.Wavelength Repeatability 3.Resolution 4.Baseline Stability 5.Baseline Flatness 6.Noise Level 7.Initialization Record Input item No. to change parameters.	⑧	Press the ① key to select "1. Wavelength Accuracy".

Screen display	Step	Description
Wavelength accuracy 1.Inspection: Yes 2.Method: D2 Lamp 3.Check λ(nm): 656.1nm 4.Tolerance: ± 0.3 nm Input item No. Recomnd	⑨	Press the ① key to change "1. Inspection" from No to Yes. * Set the other parameters as shown at the left side (see 13.2.5 "4. Wavelength Accuracy").
	⑩	Press the (RETURN) key to go back to the screen shown in step ⑧.
Settings of Auto items 1.Wavelength Accuracy 2.Wavelength Repeatability 3.Resolution 4.Baseline Stability 5.Baseline Flatness 6.Noise Level 7.Initialization Record Input item No. to change parameters.	⑪	Press the ⑤ key. * The items to be validated are highlighted.
Baseline flatness 1.Inspection: Yes 2.Scanning Range: 1100.0 ~ 190.0 nm 3.Tolerance: ± 2 mABS Input item No. Recomnd	⑫	Press the ① key to change "1. Inspection" from No to Yes. * Set the other parameters as shown at the left side (see 13.2.5 "8.Baseline flatness").
	⑬	Press the (RETURN) key to go back to the screen in step ⑧.

Screen display	Step	Description
Settings of Auto items 1.Wavelength Accuracy 2.Wavelength Repeatability 3.Resolution 4.Baseline Stability 5.Baseline Flatness 6.Noise Level 7.Initialization Record Input item No. to change parameters.	⑭	Press the ⑦ key to highlight "7. Initialization Record".
	⑮	Press the (RETURN) key.
Validation 1.Semi-Auto items 2.Auto items PhotoAccuracy WL Accuracy PhotoRepeatability WL Repeatability Stray Light Resolution Baseline Stability Baseline Flatness Noise Level Init. Record Input item No. (To start:[START]) PrintOut Settings		The titles of the items to be validated are highlighted. (In this example, "Photometric Accuracy", "Wavelength Accuracy", "Baseline Flatness" and "Initialization Record" will be validated.)

13.2.5 Detail of the validation items

<1. Photometric Accuracy>

In the validation of the photometric accuracy, the optical filter for transmittance calibration is measured (absorbance or transmittance) and then the deviation of the measured values from the standard values for calibration (standard values) that are indicated on the filter is used for the evaluation.

For the validation, the calibrated two types of filters (transmittance: approx. 10%T and 30%T) are used.

```
Photometric accuracy

1.Inspection:                Yes
2.Meas. mode:                ABS
3.Check λ(nm):
   635.0/ 590.0/ 546.1/ 465.0/ 440.0
4.10% Filter:          S/N; 110
  Good THRU;01/11/08   Tolerance;±8 mABS
5.30% Filter:          S/N; 130
  Good THRU;01/11/08   Tolerance;±8 mABS

Input item No.
 Recomnd
```

Fig. 13.2.7 Parameters Input screen for Photometric Accuracy

<Inspection>

Select Yes or No to specify whether the photometric accuracy is validated or not. Pressing the ① key will toggles between Yes and No. Once Inspection is set to Yes, the title on the Menu is highlighted.

<Meas. mode>

Select a unit for photometric values. Pressing the ② key will toggle between absorbance (Abs) and transmittance (T%). At the same time, the standard value and tolerance for the filter will change accordingly.

```
Photometric accuracy

1.Inspection:                Yes
2.Meas. mode:                T%
3.Check λ(nm):
   635.0/ 590.0/ 546.1/ 465.0/ 440.0
4.10% Filter:          S/N; 110
  Good THRU;01/11/08   Tolerance;±2 %
5.30% Filter:          S/N; 130
  Good THRU;01/11/08   Tolerance;±2 %

Input item No.
 Recomnd
```

Fig. 13.2.8 Parameter Input screen for Photometric Accuracy (transmittance mode)

Note The standard value and tolerance for the filter in the absorbance/transmittance mode are separately stored. Therefore, if the measurement mode is changed to Transmittance when the standard value and tolerance were entered in the Absorbance mode, the values entered in the Absorbance mode will not be converted into the ones in the Transmittance mode.

<Check λ (nm)>

Specify the wavelengths at which to measure the photometric values. The wavelength entered here is the wavelength tolerance for the optical filters used for the validation. For the photometric accuracy validation, five different wavelengths can be specified. The wavelength tolerance is the same for both filters.

<10%/30% Filter>

Enter the information on the 10%/30% filter used for the validation (optical filters of which transmittance is approximately 10%T and 30%T at the specified wavelength), the tolerance, and the standard values. Pressing ④ (⑤ key) on the screen shown in Fig. 13.2.7 will display the following screen:

```
Photometric accuracy
10% Filter
  1.Serial number:      110
  2.Good THRU:          01/11/08
  3.Tolerance:        ±  8  mABS
  4.Standard values:
    635.0nm; 1.039ABS  590.0nm; 1.063ABS
    546.1nm; 1.005ABS  465.0nm; 1.008ABS
    440.0nm; 1.136ABS

Input item No.
```

(Absorbance mode)

```
Photometric accuracy
10% Filter
  1.Serial number:      110
  2.Good THRU:          01/11/08
  3.Tolerance:        ±  2  %
  4.Standard values:
    635.0nm; 10.00%    590.0nm; 10.00%
    546.1nm; 10.00%    465.0nm; 10.00%
    440.0nm; 10.00%

Input item No.
```

(Transmittance mode)

Fig. 13.2.9 Parameter Input screen for 10% Filter

1. Serial number

Enter the serial number of the 10% (30%) filter. The number entered here will be saved as a validation parameter for the photometric accuracy and printed out together with the validation result.

For a serial number, up to eight numeric characters (0~9) may be entered.

Note If there is no serial number, a serial number is assigned by pressing the (ENTER) key. However, the serial number of the filter used is important as a validation record and it is therefore recommended that the S/N number of the filter or the customer's designated serial number be entered.

2. Good THRU

Enter the validity for the standard value of the 10% (30%) filter. The date entered here is saved as a validation parameter and used to automatically check to see whether the validity expires or not when the validation is performed. If the filter of which validity has expired is used, the validation cannot be performed.

Note The format for displaying the date is the same as specified in <12. Utiliites>/<6. Clock set> on the Mode screen.

3. Tolerance

Enter the tolerance (range) used to evaluate the validation result.

The unit of the tolerance changes according to the unit specified in <2. Meas. mode> in Fig. 13.2.7. The tolerance input range is between 1 and 99 mAbs for absorbance (Abs) and between 0 and 99%T for transmittance.

Note No numeric character following the decimal point can be entered.

4. Standard values

Enter the standard values for the 10% (30%) filter. The measurement wavelength for each standard value is the same as specified in <2. Meas. mode> on the screen shown in Fig. 13.2.7. Enter the standard value corresponding to that wavelength.

The unit of standard values changes according to the unit specified in <2. Meas. mode> on the screen shown in Fig. 13.2.7. The input range of standard values is between 0.000 and 9.999 Abs and between 0.00 and 99.99%% for transmittance.

<Recommended value>

Pressing the (F1) key will allow you to reset the tolerance for photometric accuracy to the recommended value (default value). The recommended value is "within ± 8 mABs" for absorbance (Abs) or "within ± 2%" for transmittance (%T).

<Meas. screen and Auto print format>

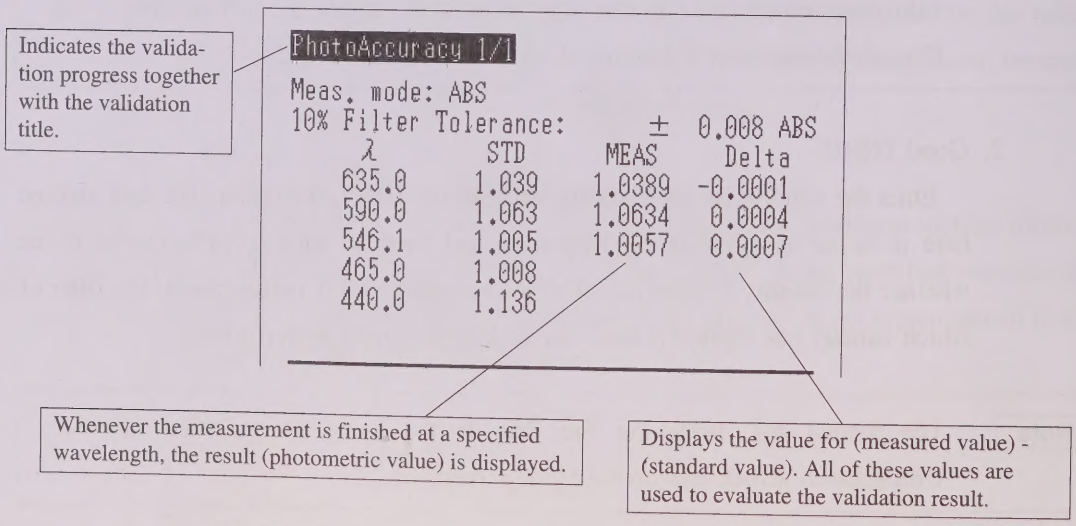


Fig. 13.2.10 Meas. screen for photometric accuracy (during the measurement using the 10% filter)

When the validation is started, the above screen appears with a message displayed at its bottom. Proceed with the validation in accordance with that message. The flow of the validation of photometric accuracy is shown below:

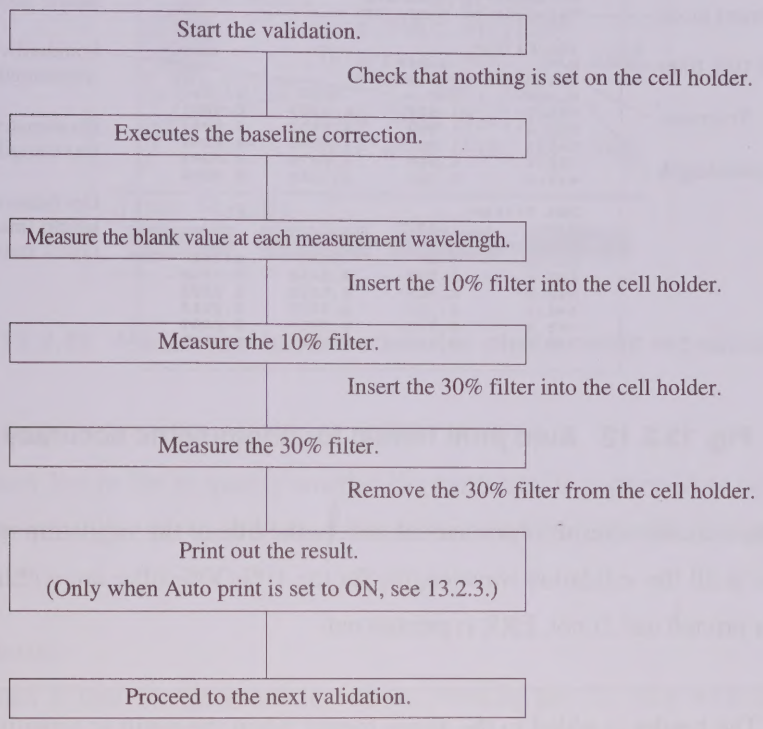
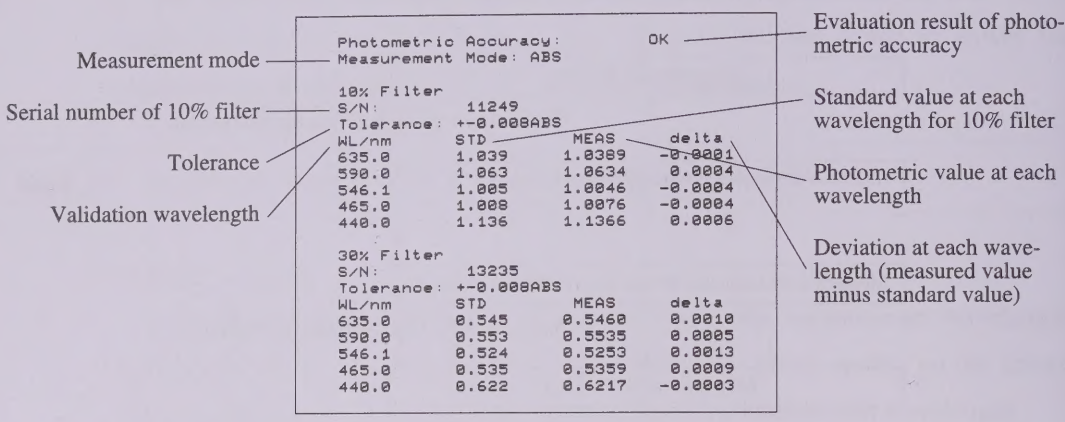


Fig. 13.2.11 Flow of validation of photometric accuracy

The format of the validation result that is printed out after the validation is shown below:




```
Photometric Accuracy:                OK
Measurement Mode: ABS

10% Filter
S/N:          11249
Tolerance: +-0.008ABS
WL/nm      STD        MEAS       delta
635.0      1.039      1.0389    -0.0001
590.0      1.063      1.0634     0.0004
546.1      1.005      1.0046    -0.0004
465.0      1.008      1.0076    -0.0004
440.0      1.136      1.1366     0.0006

30% Filter
S/N:          13235
Tolerance: +-0.008ABS
WL/nm      STD        MEAS       delta
635.0      0.545      0.5460     0.0010
590.0      0.553      0.5535     0.0005
546.1      0.524      0.5253     0.0013
465.0      0.535      0.5359     0.0009
440.0      0.622      0.6217    -0.0003
```

Fig. 13.2.12 Auto print format for photometric accuracy

The evaluation result is printed out next to the title of the validation item. If the deviations at all the validation wavelengths for the 10%/30% filter are within the tolerance, OK is printed out. If not, ERR is printed out.

Note The header is added to the above format when the result is actually printed out (For further details of the header, see 13.2.2.)

<2. Photometric repeatability>

In the validation of photometric repeatability, the optical filter for transmittance calibration is used to measure the photometric value (absorbance or transmittance) at an arbitrarily specified wavelength three times. The mean value is obtained and then the deviation of the measured values from that mean value is used to evaluate the results.

For this validation, the calibrated two types of filters (transmittance: approx. 10%T and 30%T) are used.

```
Photometric repeatability
 1.Inspection:          Yes
 2.Meas. mode:          ABS
 3.Check λ:              635.0 nm
 4.10% Filter:          S/N; 110
              Good THRU; 01/11/08
              Tolerance; Ave. ±4  mABS
 5.30% Filter:          S/N; 130
              Good THRU; 01/11/08
              Tolerance; Ave. ±2  mABS

Input item No.
 Recomnd
```

Fig. 13.2.13 Parameter Input screen for photometric repeatability

<Inspection>

Select Yes or No to specify whether the validation is performed or not. Pressing the ① key will toggle between Yes and No. If Yes is selected, the title is highlighted on the Menu.

<Meas. mode>

Select a unit for photometric values. Pressing the ② key will toggle between absorbance (Abs) and transmittance (T%) and change the tolerance accordingly.

```
Photometric repeatability
 1.Inspection:          Yes
 2.Meas. mode:          T%
 3.Check λ:              635.0 nm
 4.10% Filter:          S/N; 110
              Good THRU; 01/11/08
              Tolerance; Ave. ±1  %
 5.30% Filter:          S/N; 130
              Good THRU; 01/11/08
              Tolerance; Ave. ±1  %

Input item No.
 Recomnd
```

Fig. 13.2.14 Parameter Input screen for photometric repeatability (transmittance mode)

Note The tolerance in the absorbance/transmittance mode is independently stored. Therefore, for example, if the measurement mode is changed to Transmittance when the standard value and tolerance were entered in the Absorbance mode, the values entered in the Absorbance mode will not be converted into the ones in the Transmittance mode.

<Check λ (nm)>

Specify a wavelength at which to measure the photometric value. The standard wavelength is the same for both filters.

<10%/30% Filter>

Enter the information on the 10%/30% filter (optical filter of which transmittance at the specified wavelength is approximately 10%T/30%T) used for the validation and the tolerance. Press the ④ (⑤) key on the screen shown in Fig. 13.2.13 and then enter the serial number and validity of the filter, and the tolerance for the photometric repeatability validation in the highlighted order.

Note If the (ENTER) key is pressed without entering anything when the serial number (S/N) is highlighted, the current serial number is deleted and set to N/A.

<Recommended value>

Pressing the (F1) key will allow you to reset the tolerances for photometric repeatability to the recommended values (default values). The recommended values are shown below:

Table 13.2.3 Recommended values for tolerances for photometric repeatability

Meas. mode	10% filter	30% filter
Absorbance (Abs)	Within mean value ± 4 mAbs	Within mean value ± 2 mAbs
Transmittance (%T)	Within mean value ± 1%T	Within mean value ± 1%T

<Meas. screen and Auto print format>

Indicates the validation progress together with the validation title.

```
PhotoRepeatability 1/1
Meas. mode: ABS
10% Filter Tolerance:        ±  0.004 ABS
              1       2       3     Ave.
 Meas.   1.0378  1.0372  1.0372  1.0374
 Delta   0.0004 -0.0002 -0.0002

30% Filter Tolerance:        ±  0.002 ABS
              1       2       3     Ave.
 Meas.   0.5460
 Delta
```

Whenever the measurement is finished at a specified wavelength, the result (photometric value) is displayed.

Displays the value for (standard value) - (measured value). All of these values are used to evaluate the validation result.

Fig. 13.2.15 Meas. screen for photometric repeatability (during the measurement using the 10% filter)

When the validation is started, the above screen appears with a message displayed at its bottom. Proceed with the validation in accordance with that message. The flow of the validation of photometric repeatability is shown below:

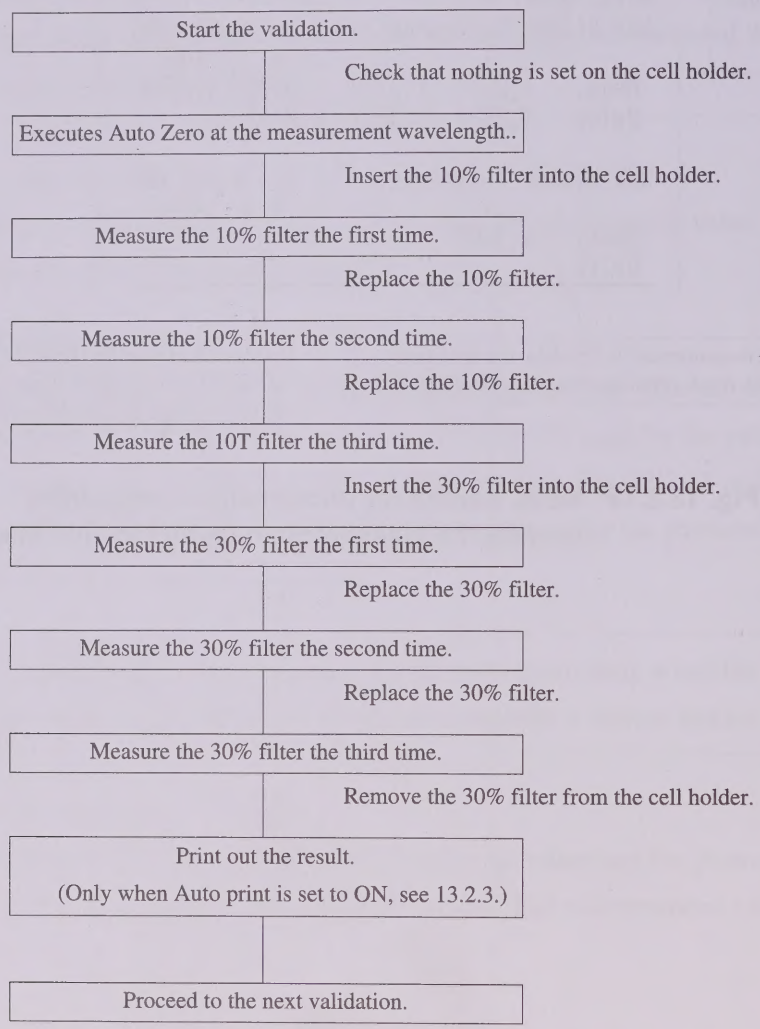


Fig. 13.2.16 Flow of validation of photometric repeatability

The format of the validation result that is printed out after the validation is shown below:

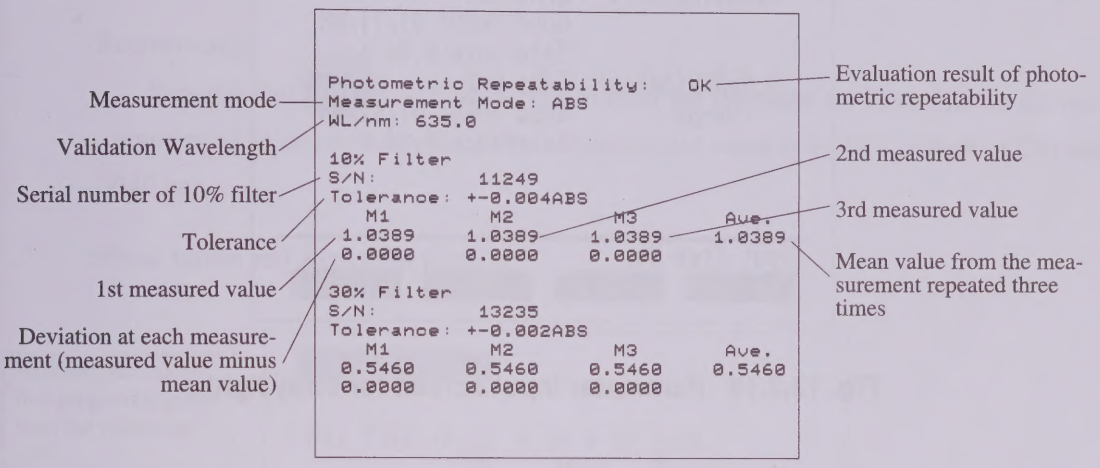


Fig. 13.2.17 Auto print format for photometric repeatability

The evaluation result is printed out next to the title of the validation item. If the deviations at all the measurement runs for the 10%/30% filter are within the tolerance, OK is printed out. If not, ERR is printed out.

Note	The header is added to the above format when the result is actually printed out (For further details of the header, see 13.2.2.)

<3. Stray light>

Stray light is represented by the ratio of the sum of light intensity at wavelengths other than the specified one to the intensity of light coming from the spectroscope at the specified wavelength. For this validation, the transmittance of an aqueous solution of sodium iodine (10 g/*l*), an aqueous solution of sodium nitrite (50 g/*l*), or the UV-39 filter is measured at 220 and 340 nm. The obtained values are defined as stray light values at those wavelengths and used to evaluate the validation result.

```
Stray light

 1.Inspection:    Yes
 2.NaI(220nm):    S/N; 001
                  Good THRU; 01/11/08
                  Tolerance:0.04 %
 3.NaNO2(340nm):  S/N; 002
   /UV-39         Good THRU; 01/11/08
                  Tolerance:0.04 %

Input item No.
 Recomnd
```

Fig. 13.2.18 Parameter Input screen for stray light

<Inspection>

Select Yes or No to specify whether stray light is validated or not. Pressing the ① key will toggles between Yes and No. Once Inspection is set to Yes, the title on the Menu is highlighted.

<NaI (220.0 nm)>

Enter the information on an aqueous solution of sodium iodine used to measure the stray light value at 220 nm, and the tolerance for stray light.

Press the ② key on the screen shown in Fig. 13.2.18, and then enter the serial number (S/N) and validity of the solution, and the tolerance for stray value at 220 nm in the highlighted order.

Note If the (ENTER) key is pressed without entering anything when the serial number (S/N) is highlighted, the current serial number is deleted and set to N/A.

<$NaNO_2$/UV-39 (340 nm)>

Enter the information on an aqueous solution of sodium nitrite ($NaNO_2$) used to measure the stray light value at 340 nm (or the UV-39 filter), and the tolerance for stray light.

Press the ③ key on the screen shown in Fig. 13.2.18, and then enter the serial number (S/N) and validity of the solution (or the UV-39 filter), and the tolerance for stray value at 340 nm in the highlighted order.

Note If the (ENTER) key is pressed without entering anything when the serial number (S/N) is highlighted, the current serial number is deleted and set to N/A.

<Recommend>

Pressing the (F1) key will allow you to reset the tolerance for stray light to the recommended value (default value). The recommended value is 0.04%T at both of 220 and 340 nm.

<Meas. screen and Auto print format>

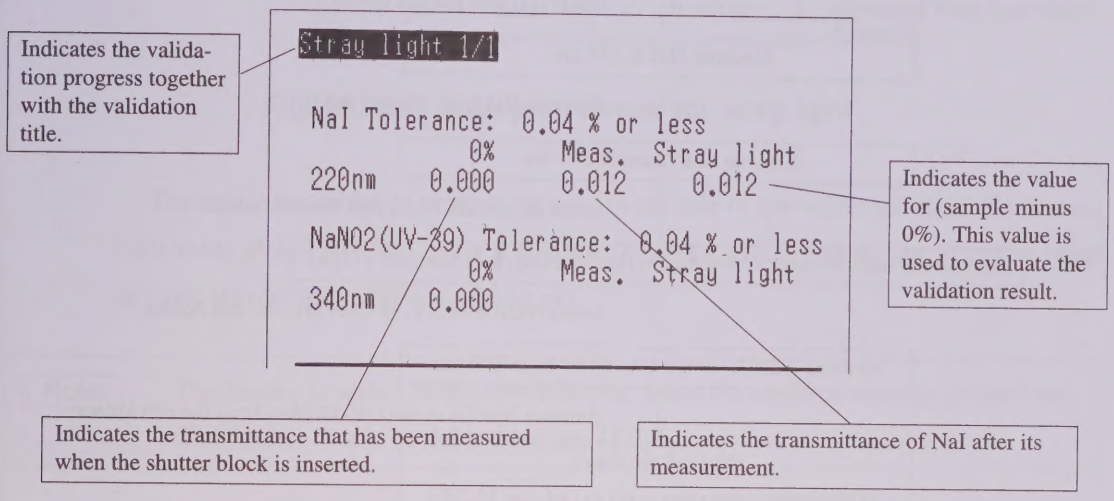


Fig. 13.2.19 Meas. screen for stray light

When the validation is started, the above screen appears with a message displayed at its bottom. Proceed with the validation in accordance with that message. The flow of the validation of stray light is shown below:

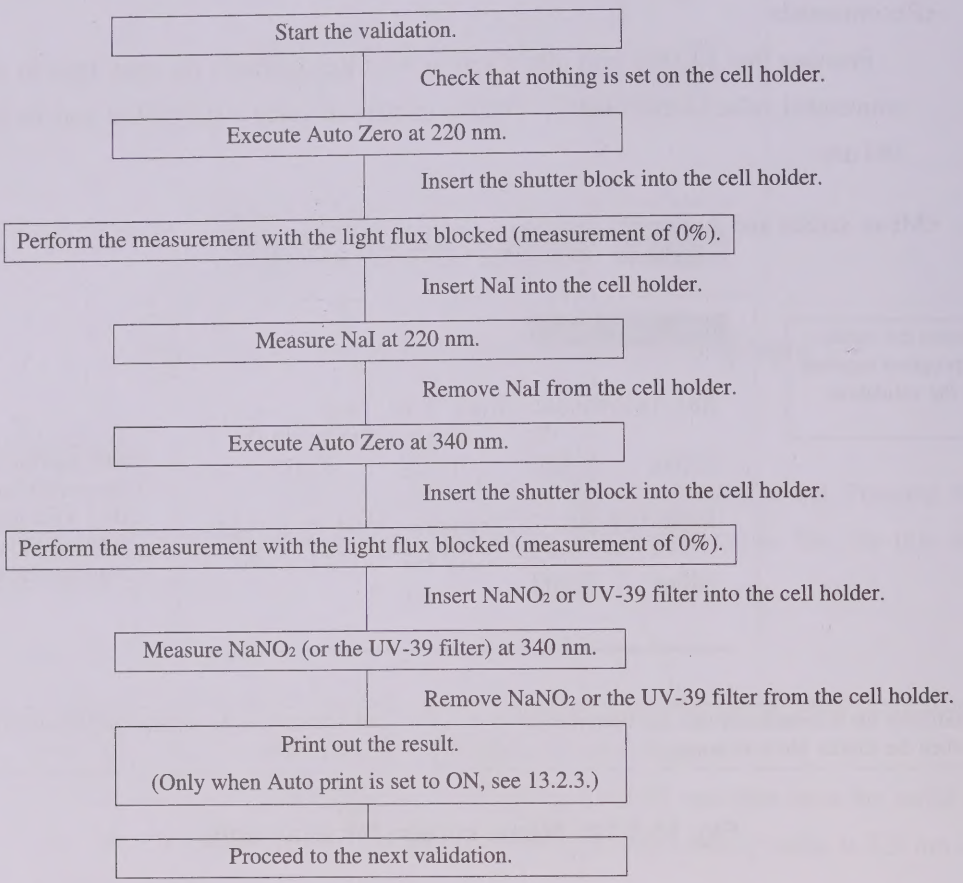


Fig. 13.2.20 Flow of validation of stray light

The format of the validation result that is printed out after the validation is shown below:

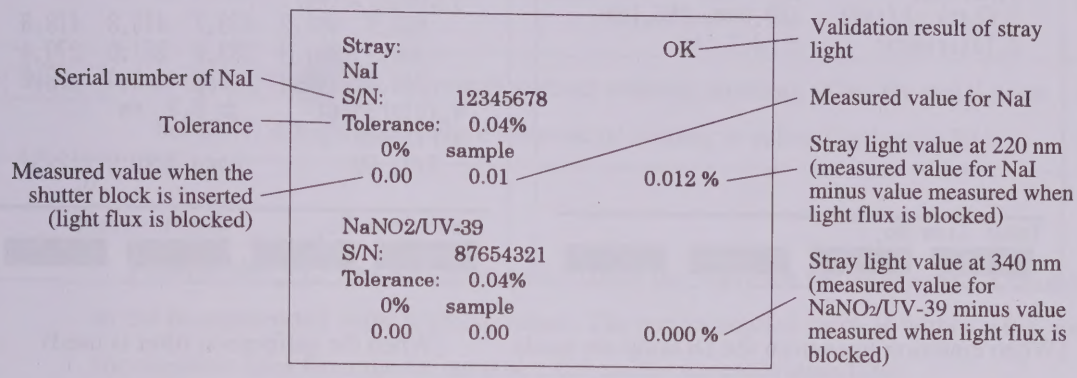


Fig. 13.2.21 Auto print format for stray light

The evaluation result is printed out next to the title of the validation item. If the stray light value at 220 and 340 nm is within the tolerance, OK is printed out. If not at either of those wavelengths, ERR is printed out.

Note The header is added to the above format when the result is actually printed out (For further details of the header, see 13.2.2.)

<4. Wavelength Accuracy>

In the validation of wavelength accuracy, emission line radiated from the deuterium (D_2) lamp used as the light source for the UV-1700 or the optical filter for wavelength calibration is measured, and then the deviation from the emission line wavelength or the reference wavelength indicated on the filter is used to evaluate the validation result.

If emission lines from the D_2 lamp are used as a validation method, this validation is performed full-automatically. If the optical filter is used, operations must be performed in accordance with the messages displayed as in the case of the semi-automatic validation, because the filter needs to be replaced before and after the validation.

```
Wavelength accuracy
 1.Inspection:      Yes
 2.Method:          D2 Lamp
 3.Check λ(nm):     486.0nm, 656.1nm
 4.Tolerance:       ± 0.3  nm

Input item No.
 Recomnd
```

(When emission lines from the D_2 lamp are used)

```
Wavelength accuracy
 1.Inspection:      Yes
 2.Method:          Filter
 3.Check λ(nm):
    536.5  460.2  453.7  445.8  418.8
    386.2  361.0  333.9  287.6  279.4
    249.2  240.9    0.0    0.0    0.0
 4.Tolerance:       ± 0.5  nm
 5.Filter:
   S/N; 99          Good THRU;01/12/31

Input item No.
 Recomnd
```

(When the calibration filter is used)

Fig. 13.2.22 Parameter Input screen for wavelength accuracy

<Inspection>

Select Yes or No to specify whether the photometric accuracy is validated or not. Pressing the ① key will toggle between Yes and No. Once Inspection is set to Yes, the title on the Menu is highlighted.

<Method>

Select which one is used as the reference wavelength, emission lines from the D_2 lamp or the absorption peak wavelength for the calibrated filter.

<Check λ (nm)>

When emission lines from the D_2 lamp are used:

Emission lines at 486.0 and 656.1 nm are radiated from the D_2 lamp. Select which emission line is used or whether both emission lines are used or not.

When the calibration filter is used:

Enter the calibrated absorption peak wavelength. A maximum of 15 wavelengths may be entered as validation wavelengths. For example, if you want to validate 12 wavelengths, enter 0 when inputting the 13th wavelength, and then press the (ENTER) key. All of the 13th and subsequent wavelengths will be displayed (set) as 0.0, and only the entered 12 wavelengths will be used for the validation (see Fig. 13.2.22).

<Tolerance>

Enter the tolerance used to evaluate the validation result of wavelength accuracy in a range between 0.1 and 0.9.

<Filter>

Enter the serial number (S/N) and validity of wavelength calibration filter used for the validation.

Note	If the (ENTER) key is pressed without entering anything when the serial number (S/N) is highlighted, the current serial number is deleted and set to N/A.

<Recommend>

Pressing the (F1) key will allow you to reset the tolerance for wavelength accuracy to the recommended value (default value). The recommended value is within ± 0.3 nm for emission lines from the D_2 lamp or ± 0.5 nm for the calibration filter.

<Meas. screen and Auto print format>

Indicates the validation progress together with the validation title.

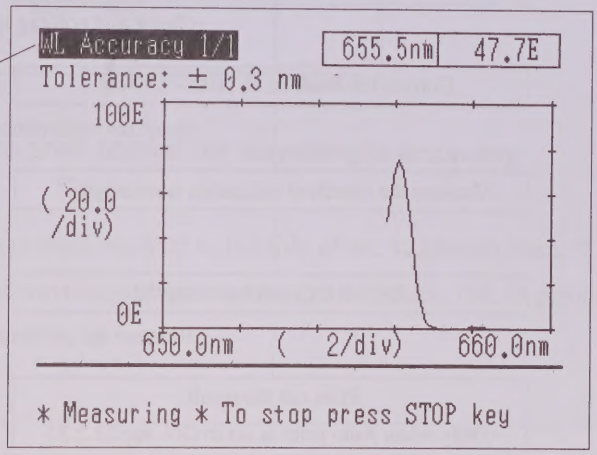
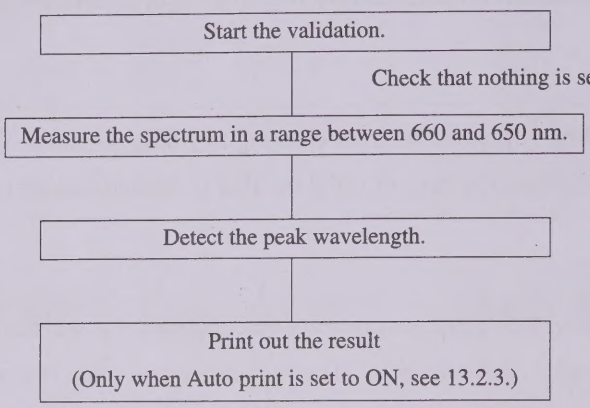


Fig. 13.2.23 Meas. screen for wavelength accuracy

When the validation is started, the Spectrum screen appears with a message displayed at the bottom of the screen. Proceed with the validation in accordance with that message. If emission lines from the D_2 lamp are used as a validation method, merely check that nothing is set on the cell holder. Subsequently, the validation will be carried out automatically. If the calibration filter is used, however, it must be changed. The flow of the validation of wavelength accuracy is shown below:

For emission lines from the D_2 lamp (at 656.1 nm only)



For optical filter

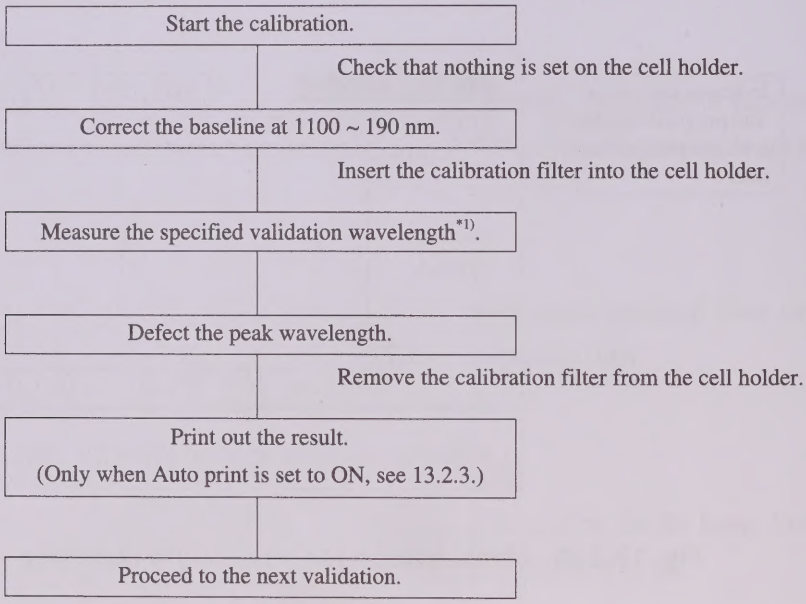


Fig. 13.2.24 Flow of validation of wavelength accuracy

*1) Measure the spectrum at each validation wavelength ± 10 nm.

The format of the validation result that is printed out after the validation is shown below:

Spectrum obtained by measuring each validation wavelength.

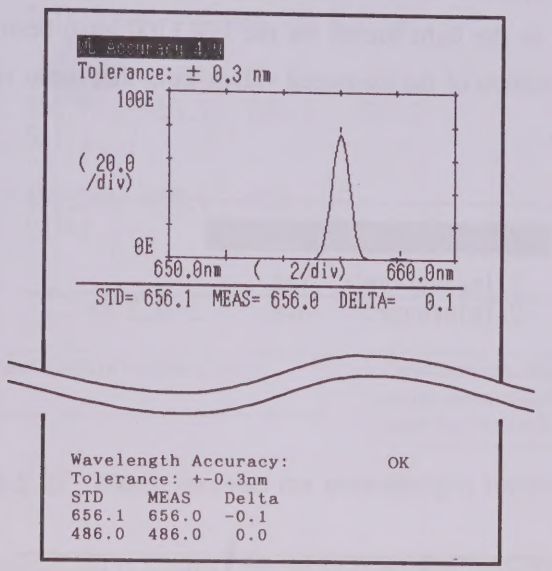


Fig. 13.2.25 Auto print format for wavelength accuracy

The evaluation result is printed out next to the title of the validation item. If the deviations at all the validation wavelengths are within the tolerance, OK is printed out. If not, ERR is printed out.

Note The header is added to the above format when the result is actually printed out (For further details of the header, see 13.2.2.)

<5. Wavelength repeatability>

In the validation of wavelength repeatability, the mean value is obtained from the detected wavelengths at which the same emission lines radiated from the deuterium (D_2) lamp used as the light source for the UV-1700 have been measured three times, and then the deviation of the measured values from that mean value is used to evaluate the results.

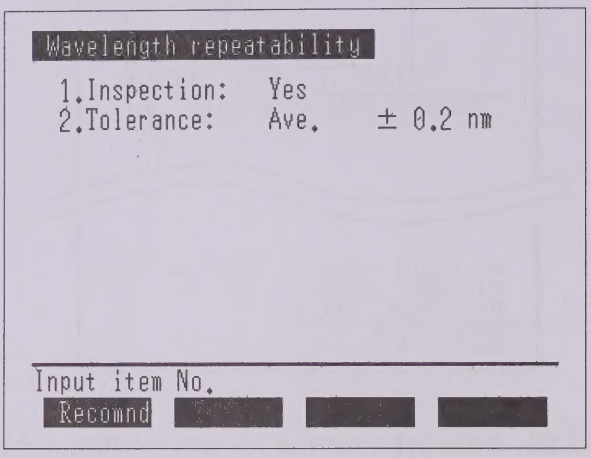


Fig. 13.2.26 Parameter Input screen for wavelength repeatability

<Inspection>

Select Yes or No to specify whether the validation is performed or not. Pressing the ① key will toggle between Yes and No. If Yes is selected, the title is highlighted on the Menu.

<Tolerance>

Enter the tolerance used to evaluate the measurement result of wavelength repeatability in a range between 0.1 and 0.9.

<Recommend>

Pressing the (F1) key will allow you to reset the tolerance for wavelength repeatability to the recommended value (default value). The recommended value is the mean value ± 0.2 nm.

<Meas. screen and Auto print format>

Indicates the validation progress together with the validation title.

```
WL Repeatability 1/1
Tolerance:      Ave. ± 0.2 nm

                 1       2       3       Ave.
656.1nm  656.1   656.1   656.1
Delta

486.0nm  486.1   486.1
Delta
```

Indicates the measurement result of emission lines (peak detection).

Calculates and displays (measured value minus mean value) after all the measurement has been finished.

Fig. 13.2.27 Meas. screen for wavelength repeatability

When the validation is started, the Measurement Result screen appears with a message displayed at its bottom. Pressing the (START/STOP) key during the measurement will abort the validation and return to the Menu (Fig. 13.2.1). The flow of the validation of wavelength accuracy is shown below:

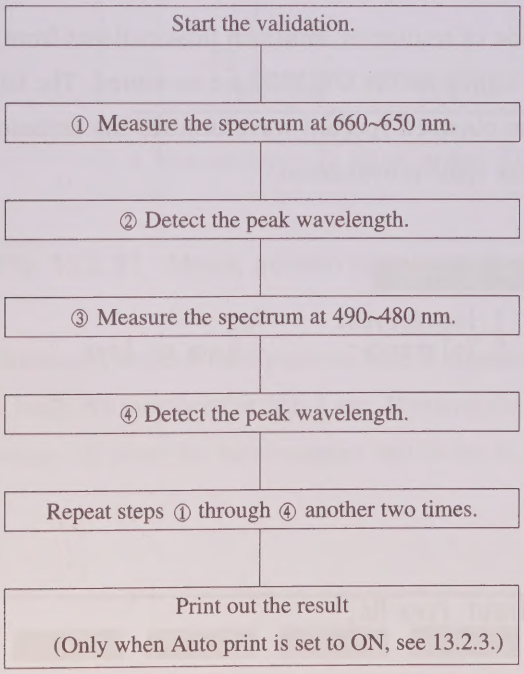


Fig. 13.2.28 Flow of validation of wavelength repeatability

The format of the validation result that is printed out after the validation is shown below:

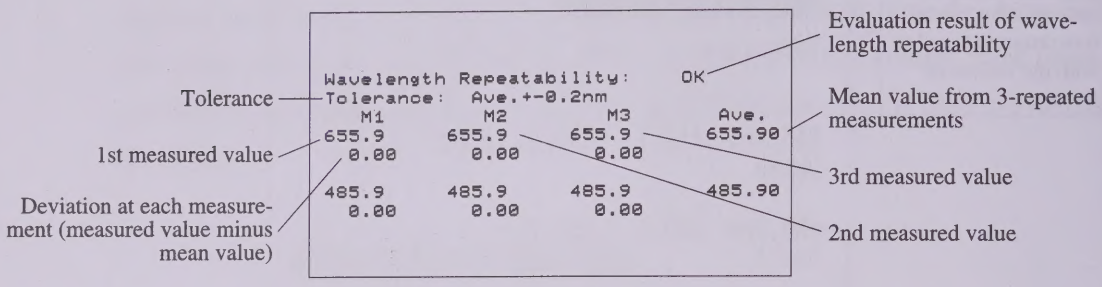


Fig. 13.2.29 Auto print format for wavelength repeatability

The evaluation result is printed out next to the title of the validation item. If the deviations at all the validation wavelengths are within the tolerance, OK is printed out. If not, ERR is printed out.

Note	The header is added to the above format when the result is actually printed out (For further details of the header, see 13.2.2.)

<6. Resolution>

In the validation of resolution, emission lines radiated from the deuterium (D_2) lamp used as the light source for the UV-1700 are measured. The half-value width (spectrum bandwidth) of the obtained spectral waveform for the emission lines is defined as the resolution, and this value is evaluation.

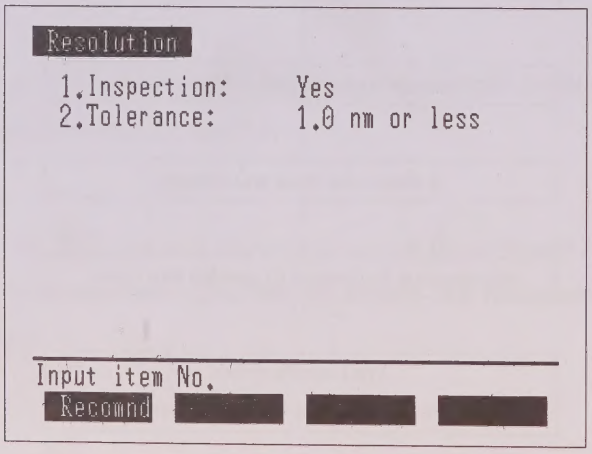


Fig. 13.2.30 Parameter Input screen for resolution

<Inspection>

Select Yes or No to specify whether the validation is performed or not. Pressing the ① key will toggle between Yes and No. If Yes is selected, the title is highlighted on the Menu.

<Tolerance>

Enter the tolerance used to evaluate the measurement result of resolution in a range between 0.1 and 0.9.

<Recommend>

Pressing the (F1) key will allow you to reset the tolerance for resolution to the recommended value (default value). The recommended value is 1.0 nm max.

<Meas. screen and Auto print format>

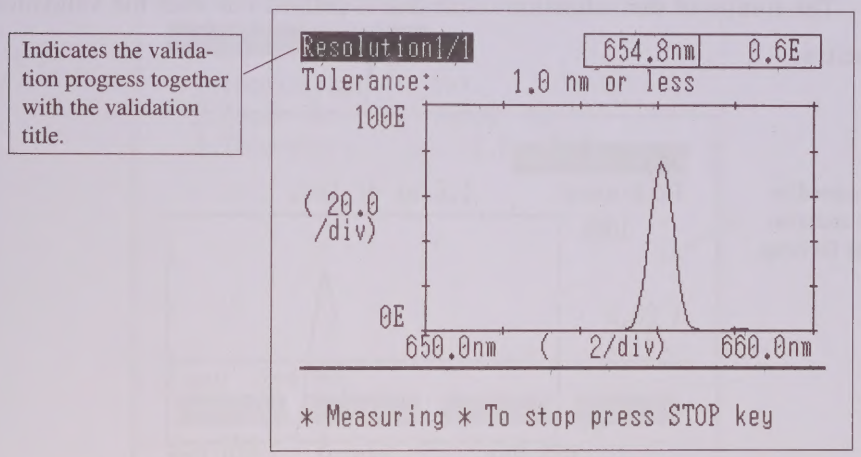


Fig. 13.2.31 Meas. screen for resolution

When the validation is started, the Spectrum screen appears and emission lines radiated from the D_2 lamp are measured at 656.1 nm. Pressing the (START/STOP) key during the measurement will abort the measurement and return to the Menu.

The flow of the validation of resolution is shown below:

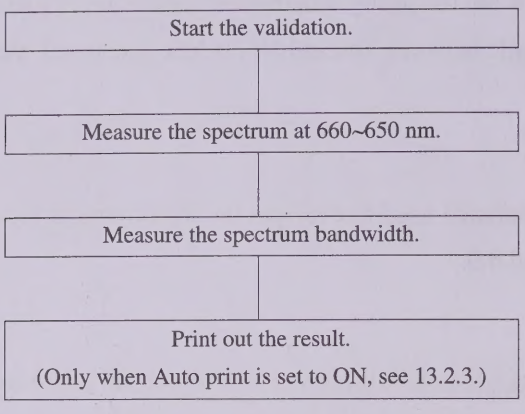


Fig. 13.2.32 Flow of validation of resolution

The format of the validation result that is printed out after the validation is shown below:

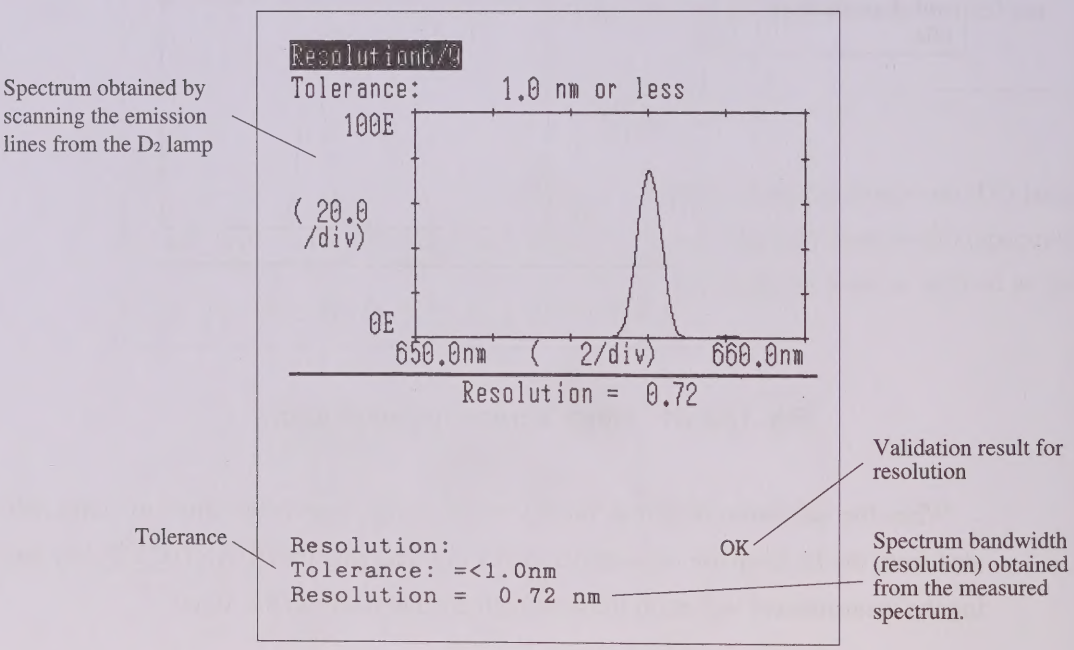


Fig. 13.2.33 Auto print format for resolution

The evaluation result is printed out next to the title of the validation item. If the resolution obtained from the spectrum for the measured emission lines is equal to or less than the tolerance, OK is printed out. If not, ERR is printed out.

Note The header is added to the above format when the result is actually printed out (For further details of the header, see 13.2.2.)

<7. Baseline stability>

In the validation of baseline stability, the time changes around absorbance of 0 Abs are measured and then the measured change per hour is defined as baseline stability. The value for baseline stability is evaluated.

The validation of baseline stability must be performed when the UV-1700 is in a stable state. Therefore, unless at least one hour has elapsed after the power has been turned ON, you are prompted to select aborting the validation or forcibly performing the validation. If the UV-1700 is allowed to stand with this message displayed, the validation will be automatically started one hour after the power has been turned ON.

```
Baseline stability
 1.Inspection:     Yes
 2.Check λ:        700.0  nm
 3.Tolerance:        1.0 mABS/H

Input item No.
 Recomnd
```

Fig. 13.2.34 Parameter Input screen for baseline stability

<Inspection>

Select Yes or No to specify whether the validation is performed or not. Pressing the ① key will toggle between Yes and No. If Yes is selected, the title is highlighted on the Menu.

<Check λ>

Enter the wavelength at which to measure baseline stability.

<Tolerance>

Enter the tolerance used to evaluate the measurement result of baseline stability in a range between 0.0 and 99.9.

<Recommend>

Pressing the (F1) key will allow you to reset the validation wavelength and tolerance for baseline stability to the recommended values (default values). The recommended validation wavelength is 700 nm and the recommended tolerance within 2.0 mAbs/H.

<Meas. screen and Auto print format>

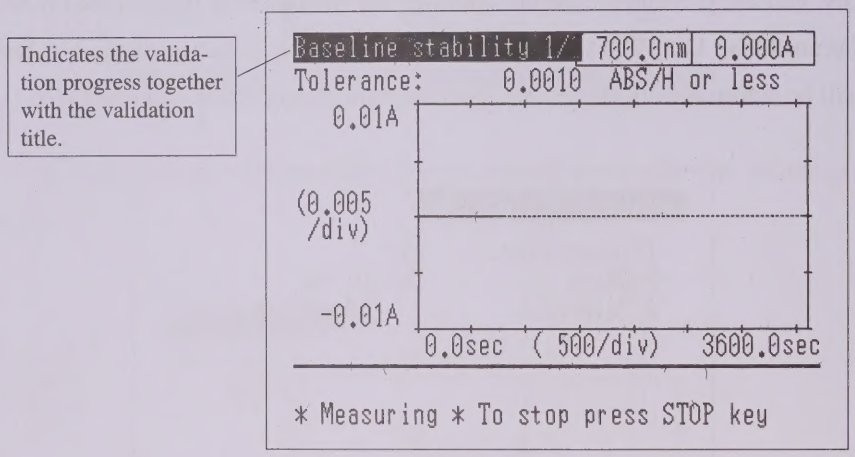


Fig. 13.2.35 Meas. screen for baseline stability

When the validation is started, the Time-course screen appears and the 1-hour time course measurement is started at the validation wavelength. Pressing the (START/STOP) key during the measurement will abort the validation and return to the Menu (Fig. 13.2.1).

The flow of the validation of baseline stability is shown below:

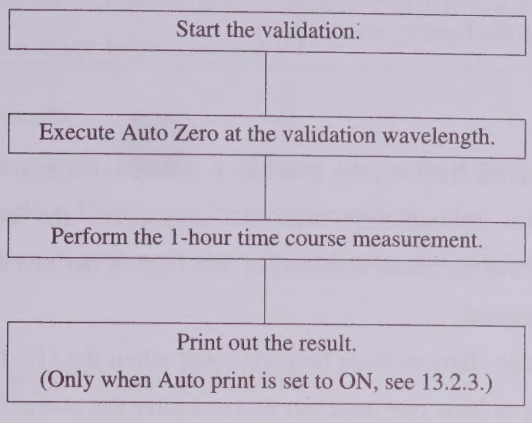


Fig. 13.2.36 Flow of validation of baseline stability

The format of the validation result that is printed out after the validation is shown below:

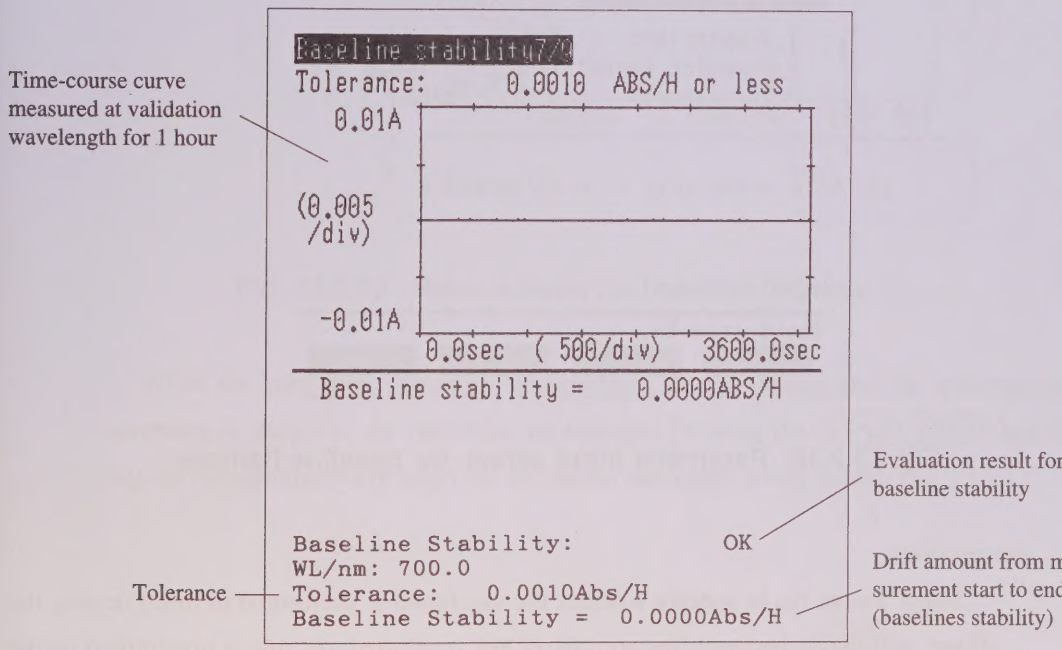


Fig. 13.2.37 Auto print format for baseline stability

The evaluation result is printed out next to the title of the validation item. If the drift amount of the validation wavelength falls within the tolerance, OK is printed. If not, ERR is printed out.

Note The header is added to the above format when the result is actually printed out (For further details of the header, see 13.2.2.)

<8. Baseline flatness>

In the validation of baseline flatness, the baseline is corrected without putting a sample in the sample module. Immediately after the correction, the wavelengths are scanned. The curvature of the spectrum obtained at that time is defined as baseline flatness, and this value is evaluated.

The validation of baseline flatness must be performed when the UV-1700 is in a stable state. Therefore, unless at least one hour has elapsed after the power has been turned ON, you are prompted to select aborting the validation or forcibly performing the validation. If the UV-1700 is allowed to stand with this message displayed, the validation will be automatically started one hour after the power has been turned ON.

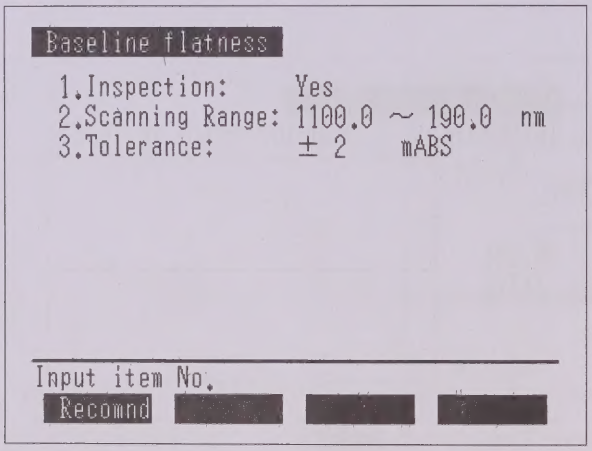


Fig. 13.2.38 Parameter Input screen for baseline flatness

<Inspection>

Select Yes or No to specify whether the validation is performed or not. Pressing the ① key will toggle between Yes and No. If Yes is selected, the title is highlighted on the Menu.

<Check λ>

Enter the wavelength range in which baseline flatness is to be measured.

<Tolerance>

Enter the tolerance (range) used to evaluate the measurement result of baseline flatness in a range between 1 and 99.

<Recommend>

Pressing the (F1) key will allow you to reset the validation wavelength and tolerance for baseline flatness to the recommended values (default values). The recommended validation wavelength is 190~1100 nm and the recommended tolerance within ± 2 mAbs.

<Meas. screen and Auto print format>

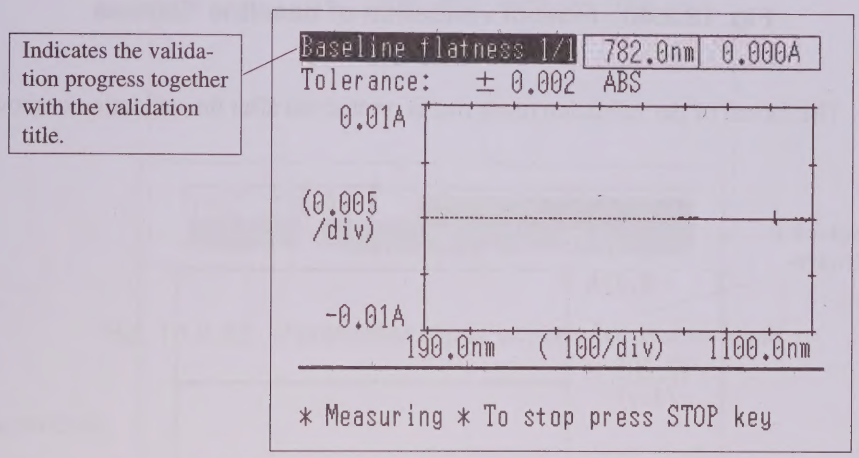


Fig. 13.2.39 Meas. screen for baseline flatness

When the validation is started, the Spectrum screen appears and the spectrum measurement is started at the validation wavelength. Pressing the (START/STOP) key during the measurement will abort the validation and return to the Menu (Fig. 13.2.1).

The flow of the validation of baseline flatness is shown below:

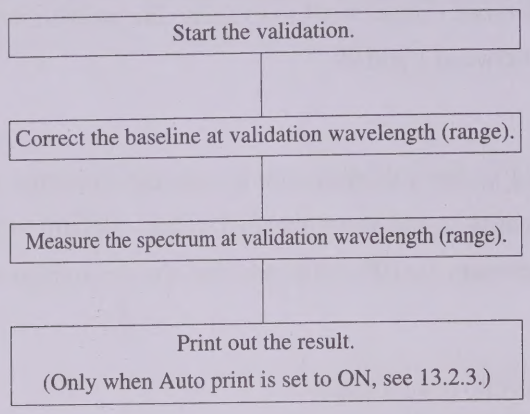


Fig. 13.2.40 Flow of validation of baseline flatness

The format of the validation result that is printed out after the validation is shown below:

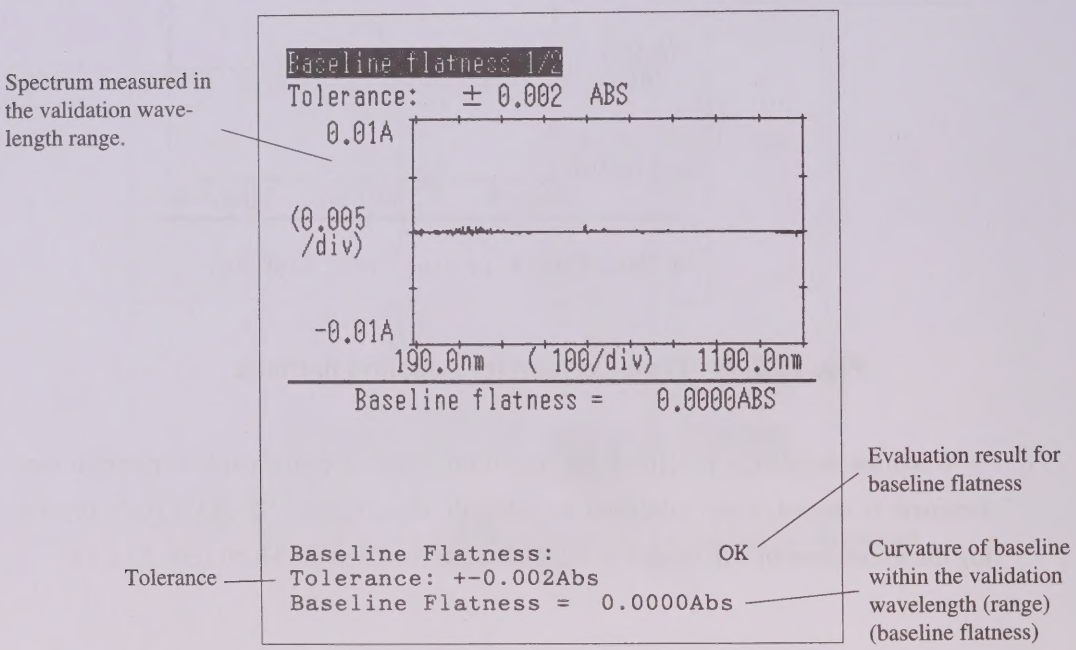


Fig. 13.2.41 Auto print format for baseline flatness

The evaluation result is printed out next to the title of the validation item. If the curvature of the baseline is within the tolerance, OK is printed out. If not, ERR is printed out.

Note The header is added to the above format when the result is actually printed out (For further details of the header, see 13.2.2.)

<9. Noise level>

In the validation of noise level, the time changes around the absorbance of 0 Abs at the wavelength specified for each model are measured for 1 minute, and the deflection of the absorbance at that time is defined as noise level (P-P). The RMS value is obtained from the measurement for 1 minute and then both of these values are evaluated.

```
Noise level

 1.Inspection:      Yes
 2.Check λ:         700.0  nm
 3.Tolerance: P-P   2.0 mABS or less
              RMS   0.2 mABS or less

Input item No.
 Recomnd
```

Fig. 13.2.42 Parameter Input screen for noise level

<Inspection>

Select Yes or No to specify whether the validation is performed or not. Pressing the ① key will toggle between Yes and No. If Yes is selected, the title is highlighted on the Menu.

<Check λ>

Enter the wavelength at which to measure noise level.

<Tolerance>

Enter the tolerance (range) used to evaluate the measurement result of noise level in a range between 0.0 and 99.9.

<Recommend>

Pressing the (F1) key will allow you to reset the validation wavelength and tolerance for noise level to the recommended values (default values). The recommended validation wavelength is 700 nm, the recommended tolerance is within 2.0 mAbs in P-P, and RMS is within ± 0.2 mAbs.

<Meas. screen and Auto print format>

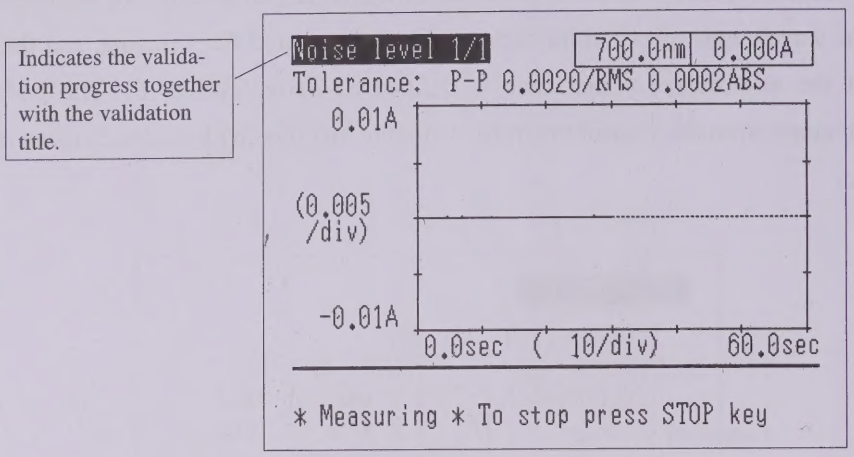


Fig. 13.2.43 Meas. screen for noise level

When the validation is started, the Time-course screen appears and the 1-minute time course measurement is started at the validation wavelength. Pressing the (START/STOP) key during the measurement will abort the validation and return to the Menu (Fig. 13.2.1).

The flow of the validation of noise level is shown below:

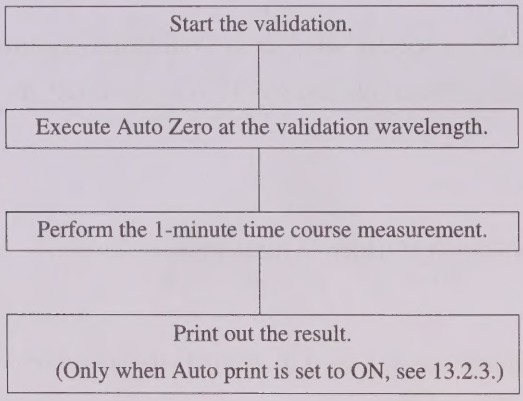


Fig. 13.2.44 Flow of validation of noise level

The format of the validation result that is printed out after the validation is shown below:

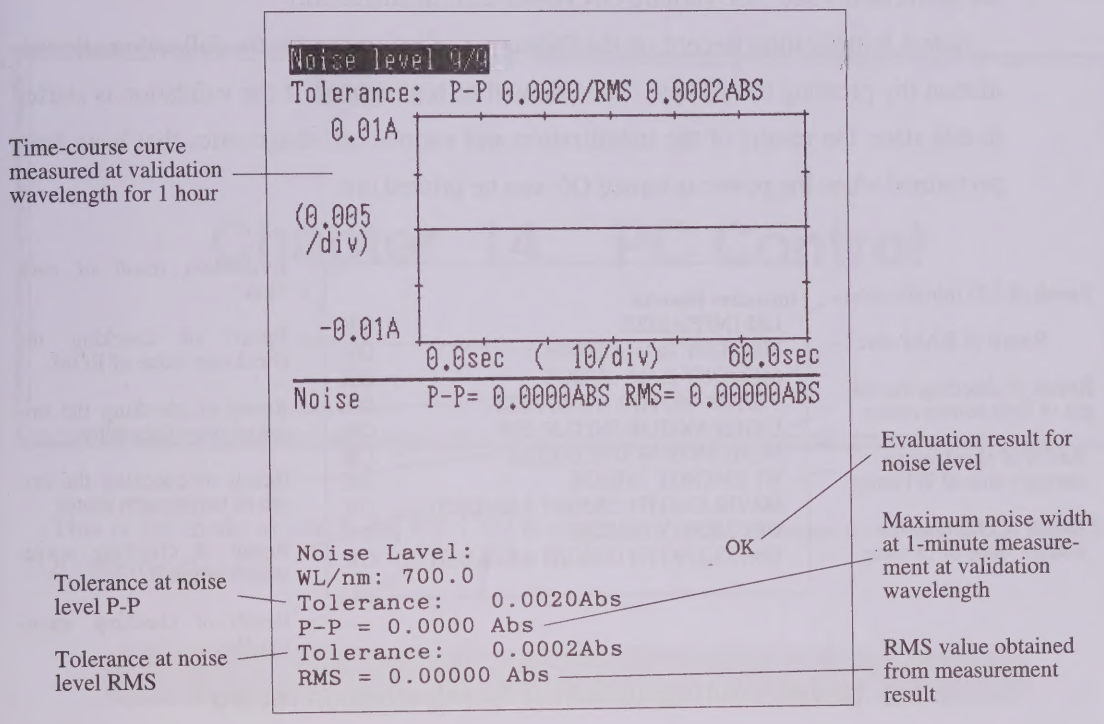


Fig. 13.2.45 Auto print format for noise level

The evaluation result is printed out next to the title of the validation item. If the maximum noise width (P-P) at the validation wavelength and the RMS value obtained from the measurement result are within the tolerance, OK is printed. If not, ERR is printed out.

Note The header is added to the above format when the result is actually printed out (For further details of the header, see 13.2.2.)

<10. Initialization record>

Every time the UV-1700 is turned ON, it is initialized and various self-diagnostics are performed. (See "1.1 Turning ON Power and Initialization.)

Select Initialization Record on the Parameter select screen for the full-automatic validation (by pressing the ⑦ key). The title will be highlighted. If the validation is started in this state, the results of the initialization and various self-diagnostics that have been performed when the power is turned ON can be printed out.

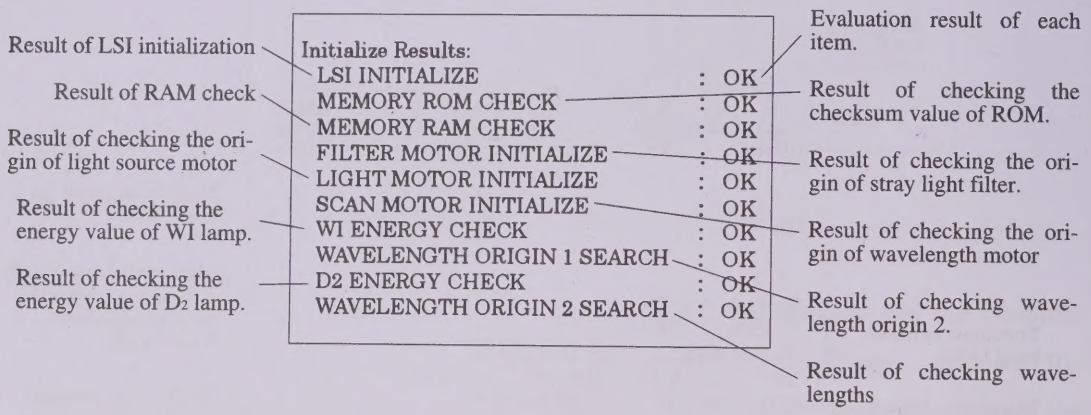


Fig. 13.2.46 Auto print format for initialization record

Note	The header is added to the above format when the result is actually printed out (For further details of the header, see 13.2.2.)

Chapter 14. PC Control

This is the mode in which the UV-1700 is controlled by an external computer (PC). An RS-232C interface is used.

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14.1 Connecting to a PC 14-2
14.2 Receiving Commands and Protocol 14-4
14.3 Example of Programming 14-6
14.4 Explanation of Commands and Data 14-10
14.5 Command List 14-11

14. 1 Connecting to a PC

Use the cable specified in the wiring specifications below as the RS-232C interface cable that connects the UV-1700 to a PC. Connect the RS-232C connector on the right side of the UV-1700 with the RS-232C connector on the PC.

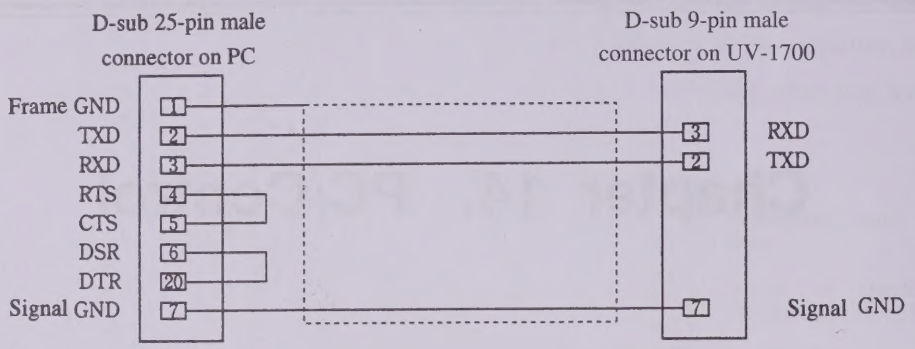


Fig. 14.1 RS-232C cable for UV-1700

The part number of this UV-1700 RS-232C cable is 200-86381.

A total of 3 wires are actually used: 2 for input/output and 1 for ground.

The connector for connecting to the PC, when seen from the PC side as above, has the control wire pins connected to each other so that input and output are always enabled. In addition, the No. 1 pin is connected to the cable shield.

In the case of an IBM-PC or DOS/V PC, a 9-pin, not 25-pin, connector is used on the external computer side. In this case, use a cable which is wired as shown below.

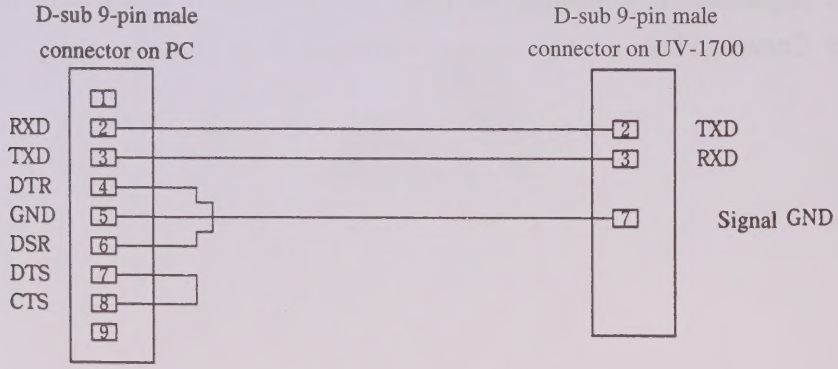


Fig. 14.2 RS-232C cable for UV-1700 (IBM)

The part number of this UV-1700 RS-232C cable is 200-86408.

A total of 3 wires are actually used: 2 for input/output and 1 for ground.

The connector for connecting to the PC, when seen from the PC side as above, has the control wire pins connected to each other so that input and output are always enabled. In addition, the No. 1 pin is connected to the cable shield.

When you select PC Ctrl (F4 key) in the mode selection screen, the following screen is displayed. It becomes possible to communicate with PC via the RS-232C interface.

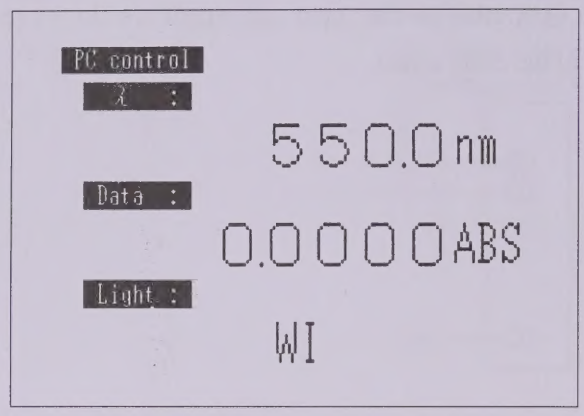


Fig. 14.3 PC control mode screen

The exchange of signals (communication) with the PC must be performed with one being the "speaker" and the other the "listener". In this case, the speaker will be referred to as the master and the listener as the slave.

The exchange of signals is performed under a set procedure (protocol). These signals comprise not only commands and data, but also codes for the control of the procedure (control codes). The control codes shown in the table below are used in the exchange of signals between the UV-700 and a PC.

Table 14.1 Control Codes

Control Code (Hexadecimal)	Direction	Function
ENQ ($05) (Enquiry)	Master to Slave	Enquiry code sent when you wish to send commands or data. In particular, the first ENQ of a series of transactions also indicates the start of communication.
EOT ($04) Enquiry)	Master to Slave	Code for announcing the end of communication. Use this when there are no more data to be sent.
ESC ($1B) (Escape)	Bi-directional	Code sent when you wish to interrupt communication.
ACK ($06) Enquiry)	Slave to Master	Code returned from receiving side in affirmative response to a command, data or code which has been sent.
NAK ($15) (Negative Acknowledge)	Slave to Master	Code returned from receiving side in negative response to a command, data or code which has been sent.
NUL ($00)	Master to Slave	Code for recognizing the end of a variable-length signal, such as a command or data, etc. This is also called the terminator.

The transmission parameters are as follows.

Transmission rate : 9600bps

Data bits : 7 bits

Stop bit : 1 bit

Parity bit : Odd

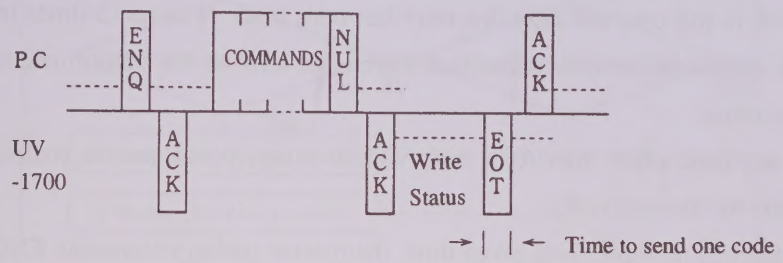
The types of commands sent from the PC to the UV-1700 can be generally classified as follows according to the direction of the data flow.

a) Write command ... Allows the status of the UV-1700 to be set.

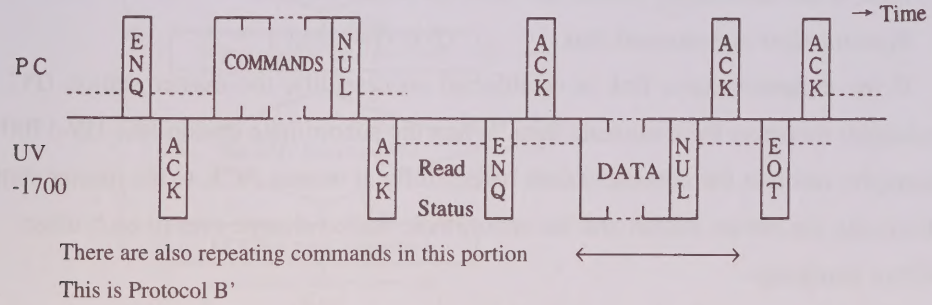
b) Read command ... Allows the status of the UV-1700 to be recognized.

The procedures for these commands have several types. A time chart is shown below. In the figure, the '——" mark indicates the master. Please note that the master and slave roles alternate in the communication process.

a) Write command ... Protocol A



b) Read command ... Protocol B, Protocol B'



The write command in a) is protocol A, the type in which data are received only once from the external computer at the read command in b) is protocol B, and when there are multiple data received it is called protocol B'.

14. 3 Example of Programming

This section further details the three transmission procedures, protocol types A, B, and B' described in the previous section, so that they can be used for your programming purpose.

N in the text stands for repetition count and is assumed to be 5 in this example.

In the flow chart, the check of repetition count and that of timeout are omitted.

Protocol type A

(1) Establishment of communication link ① in flowchart 1

Before transmitting a command, the master station (PC in this example) issues the ENQ code to a subordinate station (the UV-1700 in this example) to prompt it to receive the command data. The subordinate station returns ACK to notify the master station that it is ready to receive the command data.

<Error handling>

- If NAK is returned in response to the transmission of ENQ, ENQ is retransmitted. If NAK is still returned after this retry has been made N times (5 times in this example), the master station determines that there is an error at the subordinate station and ends the retries.
- If any code other than ACK and NAK is returned, the master station ignores it and waits for the next reply.
- If there is no reply for a given time, the master station retransmits ENQ. If no reply is received after the Nth retransmission, the master station determines that there is an error at the subordinate station and ends the retransmission.

(2) Transmission of command data ② in flowchart 1

If the communication link is established successfully, the master station (PC in this example) transmits the command data. When the subordinate station (the UV-1700 in this example) receives the command data successfully, it returns ACK to the master station. At this point, the master station and the subordinate station change over to each other.

<Error handling>

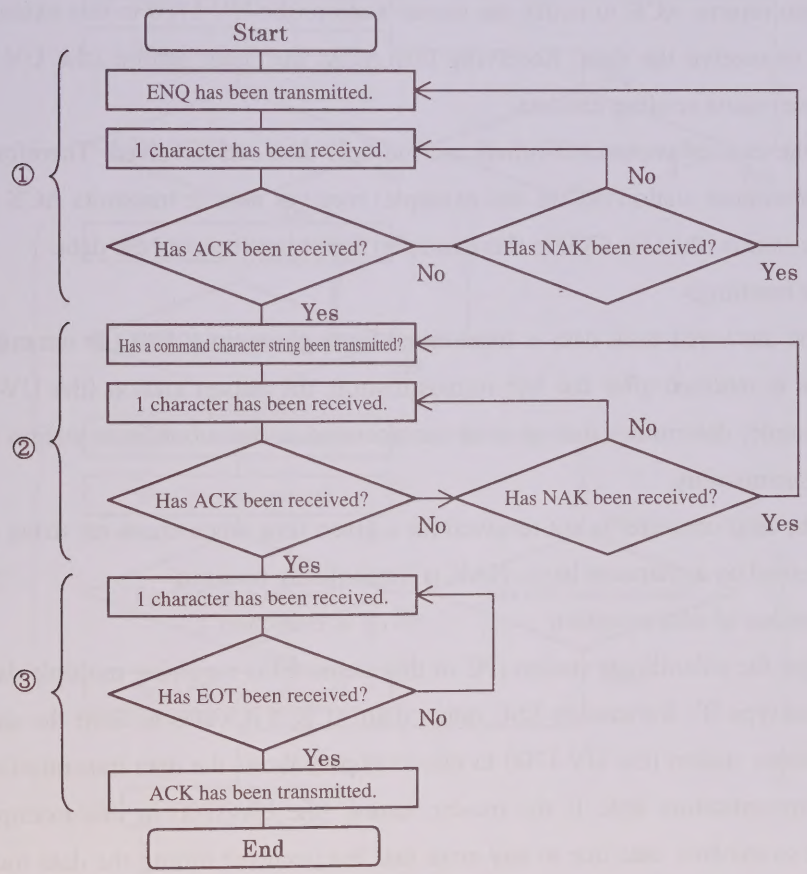
- If NAK is returned in response to the transmission of the command data, the previously transmitted data is retransmitted. If NAK is still returned after the Nth retransmission, the master station determines that an error has occurred at the subordinate station, and ends the retransmission.
- If any code other than ACK and NAK is received, the master station ignores it and waits for the next reply.
- If there is no reply for a given time, the master station retransmits ENQ. If no reply is

received after the Nth retransmission, the master station determines that an error has occurred at the subordinate station and ends the retransmission.

(3) Ending ③ in flowchart 1

When the master station (the UV-1700 in this example) processes the command data and finishes this processing, it transmits EOT to the subordinate station (PC in this example). The subordinate station waits until EOT is transmitted, and then returns ACK to end the communication.

Flowchart 1



Protocol types B and B'

(1) Establishment of communication link

This is the same as in protocol type A.

(2) Transmission of command data

This is the same as in protocol type A.

(3) Reception of answered-back data ①in flowchart 2

When the master station (the UV-1700 in this example) processes the command data and finishes this processing, it issues the ENQ code to prompt the subordinate station (PC in this example) to receive the data. The subordinate station waits until ENQ is received, and then returns ACK to notify the master station (the UV-1700 in this example) that it is ready to receive the data. Receiving this ACK, the main station (the UV-1700 in this example) starts sending the data.

In the case of protocol B', there are multiple data sets involved. Therefore, each time the subordinate station (PC in this example) receives data, it transmits ACK to notify the master station (the UV-1700 in this example) that it has received the data.

<Error handling>

- If no answered-back data is transmitted for a given time, ENQ is retransmitted. If no data is returned after the Nth retransmission, the master station (the UV-1700 in this example) determines that an error has occurred at the subordinate station and ends the retransmission.
- If the next character is not received for a given time when character string data is being received on a character basis, NAK is immediately returned.

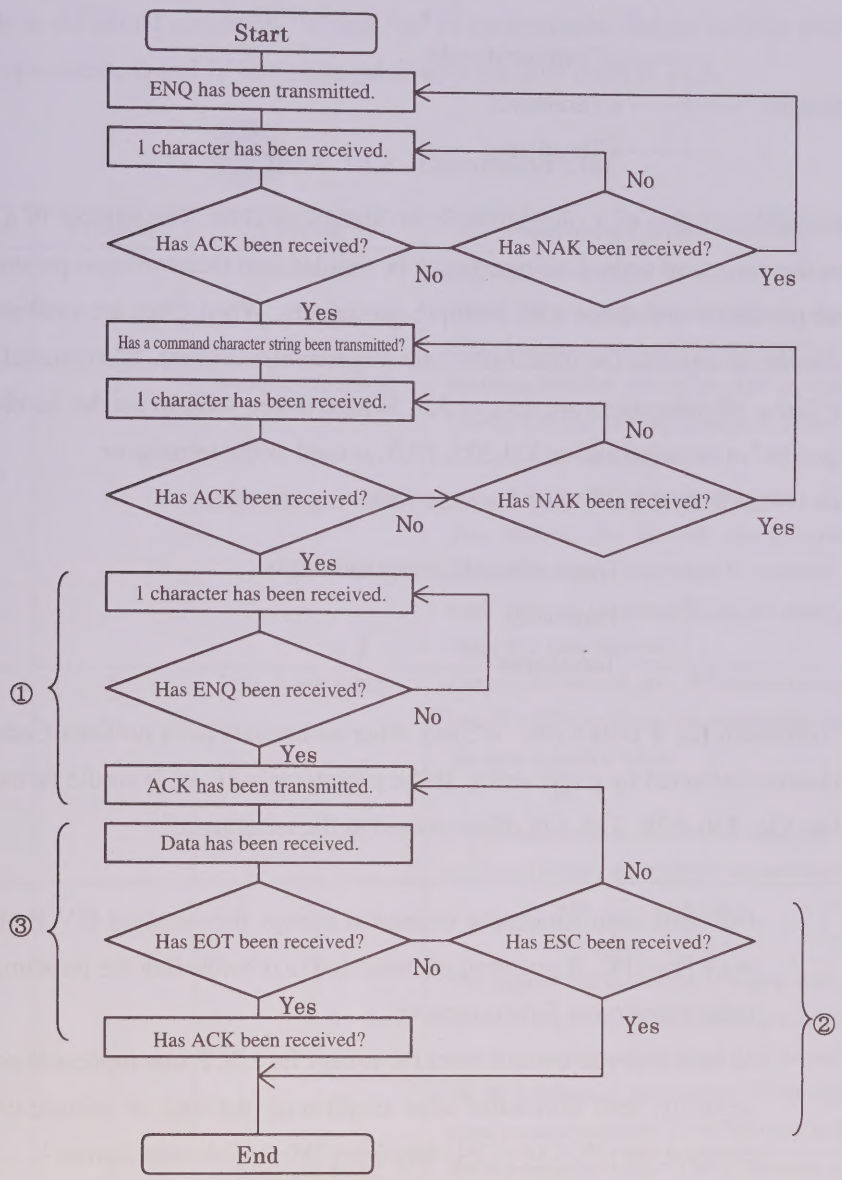
(4) Abortion of data reception ② in flowchart 2

When the subordinate station (PC in this example) is receiving multiple data sets using protocol type B', it transmits ESC rather than ACK if it wants to abort the data reception. The master station (the UV-1700 in this example) aborts the data transmission and closes the communication link. If the master station (the UV-1700 in this example) becomes unable to transmit data due to any error that has occurred during the data transmission, it transmits ESC rather than the data to close the communication link.

(5) Ending ③ in flowchart 2

When the master station (the UV-1700 in this example) finishes transmitting all the data, it sends EOT. Receiving EOT, the subordinate station (PC in this example) determines that the data reception has been finished, and then sends ACK to ends the communication.

Flowchart 2


Start
ENQ has been transmitted.
1 character has been received.
No
Has ACK been received?
Has NAK been received?
No
Yes
Yes
Has a command character string been transmitted?
1 character has been received.
No
Has ACK been received?
Has NAK been received?
No
Yes
Yes
1 character has been received.
①
Has ENQ been received?
No
Yes
ACK has been transmitted.
Data has been received.
No
③
Has EOT been received?
Has ESC been received?
No
Yes
Yes
②
Has ACK been received?
End

14.4 Explanation of Commands and Data

The commands which can be sent from an external computer are made up of the following elements.

Commands
- Command code
- Parameter
- Terminator

A command code consists of a single lower-case alphabetic code. The number of a parameter is depends on the command code. Commands can be divided into those with no parameter, those with only one parameter and those with multiple parameters. When there are multiple parameters, it is necessary to separate the parameters with a symbol (delimiter). "," (comma) is used as the delimiter. Since all parameters are sent as ASCII text, if you wish to set the number 15, this would be expressed in hexadecimal as $31,$35. NUL is used as the terminator.

Data which is sent from the UV-1601 have the following structure.

Data
- Data code ("d" command only)
- Parameter
- Terminator

Only "d" command has a Data Code "d", any other commands have no Data Code. There is only one parameter, reflected by a text string. If the parameter is 10.36, it would be expressed in hexadecimal as $31, $30, $2E, $33, $36. NUL is used as the terminator.

Caution

Not send communication command except for standard UV Probe software from PC. If you send command, it is possible that the photomater initialization do not finish correctly.

In case that you control from PC except for UV Probe (optional) software, certainly send command after confirming the end of initialization and entering the PC Ctrl (F4) key from "Mode Selection Screen".

14. 5 Command List

The terminator symbol has been omitted from the command format places in the command list. When sending to the UV-1700, send a terminator code (NUL) right after the content shown in the table as the actual command. "n" and "m" in the command format indicate parameters. The protocol types are A, B and B' and correspond with the time chart in 14.2.

Table 14.2 Command List

Command	Protocol	Name	Processing Content and Usage Notes
a	A	Measure	Performs wavelength scan. The measured data are stored in the continuous data memory area in the UV-1700. Use the f command when retrieving data.
cn	A	Baseline correction	Performs baseline correction. The parameter n corresponds with the baseline number as shown below. n = 0: baseline n = 1: instrument baseline This corrects the baseline every 1.6nm over the domain set by the scan range h command. The instrument baseline is corrected for the entire wavelength range at 0.1nm-intervals.
d	B	Data output trigger	Outputs the current data. When this command is sent, the UV-1700 performs one measurement and outputs the data as shown below. dk The parameter k is the current data and is formatted as shown below, according to the measurement mode. Abs : ± x.xxxy Not Abs : ± xxx.xy The sign of the parameter is output only if the parameter is negative, while a space is output if the parameter is positive. In addition, y is output if the number of columns of data display (Data display) instrument parameter for the UV-1700 is set to 5.
hn, m	A	Scanning range	Set the scanning range. The parameters n and m correspond with the start wavelength and end wavelength. Use a "," (comma) as the delimiter between the parameters. 190 ≦ n,m ≦ 1100 n-m ≧ 10

Command	Protocol	Name	Processing Content and Usage Notes
jn	A	Scanning speed	Set the scanning speed. The parameter n corresponds with the speed number as shown below. n = 1: Fast n = 2: Medium n = 3: Slow n = 4: Very Slow
vn	A	Measurement mode	Set the measurement mode. The parameter n corresponds with the mode number as shown below. n = 1: T% n = 2: Abs n = 3: Energy
wn	A	Wavelength setting (go to λ)	Set the wavelength. The parameter n uses the value which is 10 times the wavelength being set. To set a wavelength of 500.0nm, set 5000. n must meet the following condition. 1900 ≦ n ≦ 11000
x	A	Auto zero	Performs auto-zeroing (sets the absorbance under the current conditions at zero, or the current transmittance at 100).
fn	B'	Transfer file data	Retrieves data which have been stored in the memory area of the UV-1700 by the measure command a. The parameter n is the number of data points that you wish to retrieve, and allows you to retrieve n pieces of data from the start of the file (in the case of a spectrum, from the long wavelength end). If you set the parameter to a number which is greater than the number of data points saved in the memory area, processing will end at the point where you ran out of data. n meets the following condition. 1 ≦ n ≦ 1001 The data will be output as follows. k For the data which is sent, it is necessary to send an ACK response for each piece of data. The parameter k is a pairing of the wavelength at the time of measurement and the data. The format is as follows, depending on the measurement mode at the time (Top is Abs, bottom is not Abs). zzzz.z ΔΔ ± x.xxxy Processing Content and Usage Notes zzzz.z ΔΔ ± xxx.xy
Command	Protocol	Name	

Command	Protocol	Name	Processing Content and Usage Notes
			z is the wavelength, x and y are the measurement data and É¢ represents "space" data. The sign of the parameter is output only if the parameter is negative, while a space is output if the parameter is positive. In addition, y is output if the number of columns of data display (Data display) instrument parameter for the UV-1700 is set to 5.
o	A	Sipper suction	Execute the sipper suction operation. The settings done on the UV-1700 are used for the sipper parameters at the Spectrum mode, such as pump speed and sip time, etc. This command is valid only if a sipper 160 is connected to the sample compartment module.
p	A	Sipper purge	Execute the sipper purge operation. The settings done on the UV-1700 are used for the sipper parameters at the Spectrum mode, such as pump speed and purge time, etc. This command is valid only if a sipper 160 is connected to the sample compartment module.
qn	A	Move cell position	Move the cell position of the Multi-cell, Micro-Multi-cell holder or CPS-240. Parameter n decides the direction. n = 1: Move 1 cell forward (Multi-cell & CPS-240) n = 2: Move to the cell 1 (Multi-cell) Move 1 cell backward (CPS-240) This command is valid only if Multi-cell, Micro-Multi-cell or CPS-240 is connected to the sample compartment module.
q	B	Check cell position	Check the cell position in the multi-cell, Micro-Multi-cell or CPS-240. When this command is executed, data are returned from the UV-1700 as follows. k The parameter k corresponds with the cell position number as follows. $1 \leqq k \leqq 16$ This command is valid only when a multi-cell, Micro-Multi-cell or CPS-240 is connected to the sample compartment module.

Command	Protocol	Name	Processing Content and Usage Notes
r	B	Check ASC nozzle	Check the nozzle condition in the auto-sample changer ASC-5 (optional). If this shows that the nozzle is lowered, the sample suction operation can begin. When this command is executed, data are returned from the UV-1700 as follows. k The parameter k corresponds with the nozzle status number as follows. 0 = nozzle is raised 1 = nozzle is lowered This command is valid only when the ASC-5 is connected.
mn	A	Option initialization	Execute the initialization of option unit is connected to the sample compartment. n = B : multi-cell (6 cell) = C : CPS-240 = D : micro-multi-cell (8 cell) = E : micro-multi-cell (16 cell)

Chapter 15. Sample Module Control (Multi-cell, Sipper Operation)

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15.1 Sample Module Control (Multi-cell, Sipper Operation)

When you use a function key to call up the sample control screen from a measurement parameter configuration screen, you can set the measurement parameters for the sample module.

The 5 following accessories are available which can be mounted in place of the standard sample module and operated in synchronization with the main instrument.

1. Multi-cell (Cell holder capable of handling 6 cells.)
2. Micro Multi-cell holder (Cell holder capable of handling 8 or 16-position micro multi-cells.)
3. CPS-240 (6-cell holder with a temperature control function)
4. Sipper 160 (Perform measurements while drawing sample into a flow cell using a peristaric pump.)
5. Syringe sipper (Perform measurements while drawing sample into a flow cell using a syringe.) The syringe sipper is excellent to maintain a constant amount.

Refer to "Special Accessories Appendix A Sample Module Control (Multi-cell, shipper operation)" in the " Instruction Manual - User's System Guide" for the instructions for mounting the various accessories.

15.2 Multi-cell Sample Compartment (6-position, 8-/16-position micro multi-cell)

This accessory is equipped with max.16 sample-side cell holders and one reference-side cell holder.

The sample-side cell holders can be moved automatically or by key operations on the spectrophotometer unit.

The cell holders at the front is numbered 1.

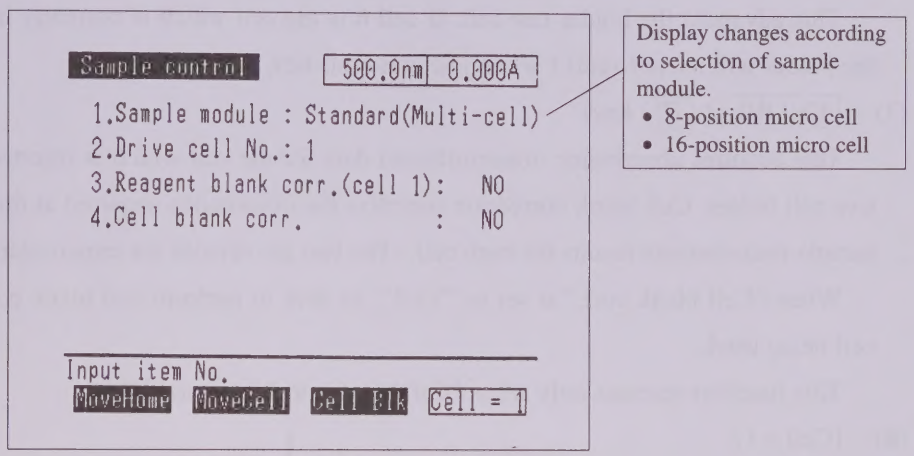

Fig. 15.1 Sample control screen (6-/8-/16-position multi-cell)

(1) Sample module

Specify the name of the instrument mounted in the sample module. Select the cell type from 1. Standard (multi-cell), 2. 8-position micro cell, or 3. 16-position micro cell.

The screen of Fig. 15.1 is displayed after initialization. Set this to 1 when the standard sample module is used.

(2) Drive cell No.

Enter the number of cells being measured.

(3) Reagent blank corr. (cell 1)

This indicates that the sample being used as the reagent blank has been placed in the cell position 1. Enter the ③ key to switch the display between "YES" and "NO".

Refer to "15.5 About the Blank Correction Function" for details about "reagent blank correction".

(4) Cell blank corr.

Set whether or not to perform cell blank correction on the measurement results. Enter the ④ key to switch the display between "YES" and "NO".

Refer to "15.5 About the Blank Correction Function" for details about "cell blank correction".

(5) MoveHome (F1 key)

This moves cell 1 (the cell inserted into the front-most cell holder) into the measurement light path.

(6) MoveCell (F2 key)

This advances the holder one cell. If cell 6 is the cell which is currently in the light path, the holder will move to cell 1 when you press this key.

(7) Cell Blk (F3 key)

This acquires absorbance (transmittance) data for the cell which is inserted in the respective cell holder. Cell blank correction subtracts the absorbance acquired at this time from the sample measurement results for each cell. (The two are divided for transmittance.)

When "Cell blank corr." is set to "YES", be sure to perform cell blank correction for the cell being used.

This function operates only when "Cell blank corr." is set to "YES".

(8) [Cell = 1]

This indicates the current cell position. (Nothing will happen if you press the F4 key.)

Note Cells cannot be automatically moved and measured in modes which are accompanied by a spectrum display (Spectrum mode, Multi-component Quantitation mode). Press the MoveCell F2 key when you wish to move the cell.

Caution Initializing the multi-cell

To initialize a multi-cell, be sure to select the already installed one and then initialize it. Once the initialization is started, it cannot be aborted. If a wrong multi-cell is selected, it may be broken.

15. 3 CPS-240

The CPS-240 is an isothermic cell holder which is used to simultaneously hold the 6 cells at a set temperature through electronic control.

The various settings are the same as for a Multi-cell. Refer to "15.2 Multi-cell Sample Component (6-position, 8-/16-position micro multi-cell)". Refer to the CPS-240 manual regarding setting the temperature of the CPS-240.

15.4 Sipper 160

This is an accessory that uses a Peristaric pump to draw liquid sample into a flow cell.

```
Sample control          500.0nm  0.000A

 1.Sample module : Sipper 160
 2.Pump speed    : Fast
 3.Sipping time  :   4.0sec
 4.Dwell time    :   1.0sec
 5.Purge time    :   4.0sec
 6.No. of rinses : 0

Input item No.                    OFF
                                  Manu.Sip
```

Fig. 15.2 Sample control screen (Sipper160)

(1) Sample module

When the sample module setting is Sipper, a screen like the one above is displayed.

(2) Pump speed

This indicates the pump rotation speed. The input range is 1 to 4: 1. Fast, 2. Medium, 3. Slow, 4. Halt. Select the 4. Halt when using the electromagnetic valve.

(3) Sipping time

Set the time that the sample will be aspirated. The input range is 0 to 99.9 seconds.

(4) Dwell time

Set the time interval between aspiration of a sample and measurement. The input range is 0 to 99.9 seconds.

(5) Purge time

Set the time after measurement is completed that the sample will be purged. The input range is -99.9 to 99.9 seconds. When set to a negative value, the pump will reverse to purge the sample, In other words, the sample will be discharged from the tube through which it was aspirated.

(6) No. of rinses

Set the number of times that the inside of the flow cell will be rinsed before measurement. The sip- purge operation will be repeated the number of times set here. Measurement is not performed during this operation.

(7) Manu.Sip (F4 key)

This key switches the manual suction function ON/OFF. Each time you press this key, the function toggles between ON ↔ OFF. Manual sipping draws the sample while the sipper lever is pressed, regardless of the sipping time setting, and no measurement is performed.

* When using the auto sample changer ASC-5 (option) for link measurement, refer to the manual for ASC-5.

15.5 Syringe Sipper

This is an accessory to sip the liquid sample to the flow cell using the syringe.

```
Sample control          1100.0nm  100.0%

 1.Sample module : Syring Sipper
 2.Pump speed    : 1.2ml/sec
 3.Sip Volume    :  0.50ml
 4.Dwell time    :   2.0sec
 5.Purge Volume  :  0.20ml
 6.No. of rinses : 0
 7.Sample recovery : ON

Input item No.
 Initial
```

Fig. 15.3 Sample control screen (syringe sipper)

Initial Initialize

When the unit is connected after turning ON the power, the accessories must be initialized with (F1) key. If they have not been initialized, the set capacity of sample may not be sipped or drained.

(1) Sample module

When the sample module is set to " Syringe Sipper," a screen like the one above is displayed.

(2) Pump speed

Select the pump operating speed from four steps: 1.2, 0.6, 0.3, 0.2 or 0.1 ml/sec.

(3) Sip volume

Set the sample sipping volume in the unit of ml. Input range is 0.00 to 10.00 ml.

(4) Dwell time

Set the time from sample sipping to measurement start in the unit of second. Input range is 0.00 to 9.99 sec.

(5) Purge volume

Set the sample purge volume after measurement in the unit of ml. Input range is 0.00 to 10.00 ml.

(6) No. of rinses

Set the number of times that the inside of the flow cell will be rinsed before measurement. The sip and purge operation will be repeated the number of times set here.

Measurement is not performed during this operation. Input range is 0 to 4 times.

(7) Sample recovery

Select the direction to which the sample is purged after measurement, the drain nozzle side or the sipping nozzle side.

The ⑦ key is used to toggle Return (ON) and Discharge (OFF).

15. 6 About the Blank Correction Function

The blank correction functions included in modes in which a Multi-cell Micro-Multi-cell or CPS-240 are available in SmplCntl are used in the following instances.

1. Reagent blank correction

   Using the sample placed in cell position 1 as a blank, the cells in the other positions (2-16) are measured. In other words, after the samples in cell positions 2 through 16 have been measured, the measured value for the sample in cell position 1 is subtracted from the various measured values.

   Because of this, even if time changes occur in the blank sample or drift develops due to the increasing temperature of the instrument, accurate data can be acquired by canceling these fluctuating factors.

2. Cell blank correction

   Even though cells are constructed in the same manner, there are naturally going to be slight optical differences. In cell blank correction, at first blank samples are placed in a square cells and the measured values in that condition are recorded. Then, when an unknown sample is measured and those results are displayed, the previously recorded blank measured value is canceled from the various measurement results. Thus, the measured value of only the sample is obtained.

Note	In case that you carry out "Cell blank correction" (F3) key, the correction do to all cell position in no relation to setting value of "Drive cell No." in parameter of sample compartment.

If both of these two blank correction functions are functioning, the measured value for the other cells can be corrected with the sample in cell 1 as the reagent blank, while also performing a cell blank for each individual cell.

Blank correction is one type of data processing and is calculated as subtraction for absorbance and division for transmittance.

Note that the standard measurement modes in which the blank correction function can be used are the Photometric mode, Kinetics mode and one-wavelength quantitation.

Table 15.1 Blank Correction List

	Cell Position		Cell blank corr.=NO Reag blank corr.=NO	Cell blank corr.=NO Reag blank corr.=YES	Cell blank corr.=YES Reag blank corr.=NO	Cell blankcorr.=YES Reag blank corr.=YES
Output Data	Cell n (n=2-6)	ABS	An	An−A_1	An−an	(An−an)−(A_1−a_1)
		T%	Tn	Tn/T_1×100(%)	Tn/tn×100(%)	Tn•t_1/t_n/•T_1×100(%)
	Cell 1 (Cell used as reagent blank)	ABS	A_1	A_1	A_1−a_1	A_1−a_1
		T%	T_1	T_1	T_1/t_1 × 100(%)	T_1/t_1 × 100(%)

Wherein,

An : Absorbance with no blank correction on cell n

Tn : Transmittance with no blank correction on cell n

an : Cell blank value for cell n (absorbance)

n : Cell blank value for cell n (transmittance)

Note The range over which correction can be performed, due to internal data processing calculation restrictions, are up to 399.9% for transmittance and down to –0.602Abs for absorbance.

When a blank correction function is working, accurate data are obtained only when an actual measurement operation has been performed (when the (START) key has been pressed). Please note that the value displayed in the upper right corner of the sample control screen or measuring mode, which indicates the current value, displays the uncorrected value.

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